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An investigation of problem-solving theory
and its relationship to
composition theory and pedagogy

by

Suzanne M. Kelsey

A Thesis Submitted to the
Graduate Faculty in Partial Fulfillment of the
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TABLE OF CONTENTS

	Page
CHAPTER I INTRODUCTION	1
CHAPTER II COGNITIVE PSYCHOLOGY: THE NEW APPROACH TO LEARNING ABOUT HUMAN PROBLEM SOLVING	5
CHAPTER III RELATION OF PROBLEM-SOLVING THEORIES TO COMPOSITION THEORIES	20
CHAPTER IV COGNITIVE STUDIES OF THE WRITING PROCESS	26
CHAPTER V ISSUES IN COGNITIVE RESEARCH ON THE WRITING PROCESS	58
CHAPTER VI PEDAGOGICAL IMPLICATIONS	68
WORKS CITED	101

CHAPTER I

INTRODUCTION

Composition as an academic field is still in its infancy. While college students in the United States are now regularly required to take composition classes, it wasn't until the mid-nineteenth century that such classes began to be offered as a standard part of the college curriculum (Underwood 9). Theorists have borrowed concepts and ideas from other disciplines as they have developed the discipline of composition, resulting in a virtual explosion of conceptualization and research in composition in the last twenty-five years.

One of the composition theorists borrowing from other disciplines is Janice Lauer, who has advocated a return to Aristotle's principles of rhetoric for invention strategies. She has helped to revive Aristotle's topics, or methods of invention (Lauer, Seminar). Young, Becker, and Pike's tagmemic theory, which was borrowed from the discipline of linguistics, which borrowed it from physics, is another example of discipline transfer (Young and Becker, "Toward a Modern Theory" 130). The concept of "synectics," or using analogy as a way to explore a topic, has been borrowed from a group of inventors, artists, and psychologists trying to find creative solutions to problems (Flower, Problem-Solving Strategies for Writing 85).

Such invention strategies are commonly included in the category of "heuristics." Heuristics are devices which people use in their attempts to solve a problem, such as writing a paper. Unlike rules and algorithms, which are completely systematic plans (such as mathematical equations), heuristics are somewhat systematic "in a clever way," in the middle of the continuum between algorithms and trial and error (Lauer, Seminar). People often intuitively use methods to solve problems without realizing what these methods are. Explicating those intuitive methods makes them heuristics ("Problem-Solving Strategies and the Writing Process" 450-1). Heuristics also can be used in other stages of the writing process besides invention, such as audience analysis and revision.

While some composition theorists have turned to classical rhetoric and various other disciplines for heuristics that can be useful in the composing process, others have turned to more scientific methods. Borrowing methods and terminology from the field of cognitive psychology, these theorists attempt to discover what actually goes on in a person's brain when that person is writing; that is, they are studying the cognitive aspects of the writing process. These cognitive theorists are using their research to identify various heuristics that writers actually use. They feel that the heuristics, once identified, can be used for writing instruction.

Linda Flower, who works closely with cognitive psychologist John Hayes at Carnegie-Mellon University, is one of the most prominent of the composition theorists who are applying cognitive research to the study of writing. Flower and Hayes have defined writing as a "problem-solving" process and have attempted, primarily through protocol analysis, to find out what writers do as they solve the "problem" of writing. The work of cognitive theorists, to be sure, is not received without skepticism by many in the field of composition. However, it is possible to draw, from the work of Flower and Hayes and others, a set of implications for pedagogy that can be useful in teaching the composition process.

Chapter II of this study will first address the discipline of cognitive psychology, and try to answer the following questions: What is cognitive psychology? What is problem solving and why does cognitive psychology study it? In Chapter III, the focus will turn to the connection between cognitive psychology, problem solving, and writing. What is the connection? How is it studied? In Chapter IV, the researchers will be discussed: Who is researching the cognitive processes involved in writing as a problem-solving activity? and What are they finding out? Chapter V will address some of the limitations: What are some of the issues and problems with the cognitive theorists' works? Finally, and probably most importantly, Chapter VI will try to answer the questions: What does all this mean for instructors who

must face their composition classes on Monday morning? What parts, if any, of current theory on the problem-solving process of writing might they want to implement in their classrooms? And: How do they do it?

CHAPTER II
COGNITIVE PSYCHOLOGY:
THE NEW APPROACH TO LEARNING ABOUT HUMAN PROBLEM SOLVING

The field of psychology has undergone numerous changes within this century. Howard Gardner notes that even in the early 1960s, "psychology seemed a rather remote and sterile area to individuals interested in the full and creative use of the mind." According to Gardner, academic psychology, behaviorism, and psychoanalysis were the main areas studied. Academic psychology featured the use of contrived laboratory apparatus which studied "the perception of visual illusions or the memorization of long lists of nonsense syllables." Behaviorism based its theories on the idea of reinforcement for behavior and consequently "denied inner life--no thoughts, no fantasies, no aspirations." Thus, studies of human thought processes and use of language were largely ignored by behaviorists. Psychoanalysis emphasized human personality and the unconscious, but said "little about rational thought processes or conscious problem-solving" (Gardner 3).

The Cognitive Revolution

Gardner describes the cognitive revolution, which he says came in two parts. "First, there was the frank recognition that one could--one must--take seriously human mental processes, including thinking, problem-solving, and creating." The study of the mind was considered a more valid activity than some had

considered it to be in the past. Second, researchers demonstrated that "human thought processes were characterized by considerable regularity and structure." While not all of these thought processes could be directly observed, there was "structure to thought processes, a structure the careful analyst could help lay bare" (4). Cognitive psychologists concern themselves, then, with the structure of thought processes.

John Hayes agrees with Gardner's assessment that a cognitive revolution occurred in the late 1950s and early '60s. He attributes the revolution, however, more specifically to two publications which appeared in the late 1950s. One was "Elements of a Theory of Human Problem Solving" (1958), a paper by Herbert Simon and Allen Newell. The other was Noam Chomsky's "A Review of B.F. Skinner's Verbal Behavior" (1959). These and subsequent articles featured three factors which, says Hayes, were important in the growth of cognitive psychology:

1. The growing awareness among psychologists that complex mental structures were essential to psychological theories as exemplified by Piaget.
2. The Behaviorists' failure to make progress in describing language led many (such as Chomsky) to believe that a new theoretical approach was desirable.
3. The development of information-processing models (such as that of Simon and Newell) provided a new approach which facilitated the description of complex mental structures.
(Paraphrased from Hayes, Cognitive Psychology 151)

Again, cognitive psychologists concern themselves with the structure of thought processes, or the "description of complex mental structures" in relation to human thought and behavior. This concern has taken them into such areas as the psychological processes underlying language generation, problem solving, and creativity. For example, research in artificial intelligence by cognitive psychologists has enhanced knowledge about language generation, which in turn has caused researchers to examine "the processes involved in understanding larger units of language--paragraphs, stories, problem descriptions, scripts, and even whole belief systems" (169).

Because cognitive researchers have extended their focus to larger units of language, composition theorists have also begun to apply cognitive research to the field of composition, causing a revolution of their own. (Work of composition theorists will be discussed in Chapter III.)

Problem Solving

One of the psychological processes studied widely by cognitive psychologists is that of human problem-solving behavior. Within this domain, three main models have been offered: (1) information processing models; (2) models stressing human abilities and factors; and (3) creative problem solving models (Feldhusen and Guthrie 22). The cognitive process models used by composition theorists are primarily related to the information

processing models, upon which the remainder of this chapter will focus.

The Information Processing Model

To date the most important information processing model comes from Newell and Simon in their 1972 text, Human Problem Solving. Because their work is drawn upon extensively by Flower and Hayes in their cognitive model of writing, it will be useful to lay out a few of Newell and Simon's concepts.

The fundamental components of Newell and Simon's information processing model include:

1. a long-term memory function
2. a short-term memory function
3. serial processing, limited by individual rates of processing
4. information about the environment acquired by the different sensory systems
5. problem solving behavior affected by external memory aids
6. goal-directed problem solving (Paraphrased from Feldhusen and Guthrie 9)

Such an information processing model, in addition to stating generalities about human behavior, can "represent in some detail a particular man at work on a particular task." This representation is not a metaphor (e.g., computer for man), but a "precise symbolic model" which can help calculate aspects of human problem solving behavior (Newell and Simon 5).

This model remains approximate, especially since its emphasis on performance omits motivational and personality variables, but Newell and Simon believe that it "posits internal mechanisms of great extent and complexity, and endeavors to make contact between them and the visible evidences of problem solving" (10).

Feldhusen and Guthrie believe that the Newell/Simon model is a valid representation of human problem solving because it clarifies parts of the problem-solving process and begins to suggest instructional activities.

Memory

But more crucial to our discussion here is the Newell/Simon model's obvious reliance upon factors involving memory. The ability to remember information is critical to the problem-solving process, and, as we have seen, plays a primary role in the information processing model. Psychologists who have studied the structure of human memory theorize that people remember things in "chunks," which are "package(s) of information that (are) treated as a unit." Further, psychologists have determined that the capacity of short-term memory is seven chunks, plus or minus two (Hayes, Problem Solver 73). Chunking is an activity that people perform, even if they are not aware that they are doing it (75); people can make remembering easier if they consciously search for chunks. Of course, writing these chunks down, or representing them externally through a diagram or matrix, can free up our

short-term memory for other tasks, thus making our problem-solving efforts more efficient.

Frederiksen labels the short-term memory, "working memory." He notes that there are "two kinds of information processing: controlled and automatic." A controlled process requires deliberate attention and is under the control of the person. It involves the activation of chunks, or what Frederiksen also calls "nodes." Consequently, "controlled processing. . . quickly uses up the capacity of working memory." Automatic processing is carried out without the person's attention, so it doesn't use much or any of the capacity of working memory. Problem-solving capacity can be "greatly increased by learning to use automatic processing for the more routine elements of an activity, making available controlled-processing resources for the novel aspects of problem solving." Frederiksen gives the example of reading to illustrate his point. The basic skills that we learn, such as "decoding orthographic forms, translation into speech units, retrieving word meanings, and establishing relationships among semantic propositions," become automatic, which make it possible for us to simultaneously process large amounts of information (364-366).

Long-term memory is also important to the problem-solving process. The remembering of old patterns can aid us in new problem-solving situations. Further, knowledge located in our long-term memory is important in problem solving. Says Hayes, "If you are missing relevant knowledge, an easy problem may appear

difficult or impossible. . . . Much that passes for cleverness or innate quickness of mind actually depends on specialized knowledge (Problem Solver iv-v). While the short-term memory may handle about seven chunks, the capacity of long-term memory "is thought to be virtually limitless" (Frederiksen 364), a proposition that will be vital when we come to applications of problem-solving theory to the writing process.

Successful Problem Solving

Hayes, whose problem solving text builds on the work of Newell and Simon, says there is a problem "whenever there is a gap between where you are now and where you want to be, and you don't know how to find a way to cross that gap" (Problem Solver i). Another definition of a problem is that "A problem exists when 'what is' differs from 'what is desired'" (Pfeiffer et al. 104). Solving a problem, according to Hayes, involves finding a way to cross the gap.

Success in "crossing the gap," says Hayes, depends on how effectively the following activities are carried out:

1. Finding the problem
2. Representing the problem
3. Search, or planning the solution
4. Carrying out the plan
5. Evaluating the solution

6. Consolidating gains. (Problem Solver 1)

"Problem representation," "search" (planning the solution), and "evaluating the solution" are three of the major activities involved in finding answers to problems. Following is a discussion of these three activities.

Problem Representation:

According to Hayes, there are four elements that people may need to include when they internally represent problems:

1. The Goal--where we want to be when we are done.
2. The Initial State--where things are at the beginning of the problem.
3. The Operators--the actions that change one problem state into another.
4. The Restrictions on the Operators. (3-4)

While all problems involve at least a goal, one or more of the other parts may be absent or omitted in a problem. Hayes uses the example of a friend saying to another friend, "Get to my house at ten o'clock" (4). This problem states the goal, but specifies no initial state (where to start from), no operators (how to get there), and no restrictions (how not to get there).

People represent problems to themselves in a variety of ways. Some are better than others at filtering out irrelevant detail. Some represent problems to themselves in visual imagery, others in

sentences, others in auditory images (Hayes 7-8). How problems are represented can make a big difference in the difficulty of the problem (ii). Frederiksen says, "An inaccurate or incomplete problem representation may make it difficult or impossible to solve the problem" (367). For example, external representations, such as sketches, lists, equations, and diagrams may be helpful, if not necessary, in a problem-solving situation. These aids can help the problem solver to remember information and to discover new relations in the problem (Hayes, Problem Solver 11).

Hayes notes that people may change their internal and/or external representations of the problem as they are solving them. In fact, if they are experiencing difficulty in solving the problem, it may be helpful to change the representation (14). For instance, "Joe" might have difficulty in solving a writing problem which he has internally represented as, "I need to write an 'A' paper for my composition class." Joe might be better able to solve his problem by changing his problem representation to something like, "I need to write a paper on something I'm vitally interested in so that I can enjoy myself while I research it and write it, and so that I can hopefully get a better grade."

However, sometimes an inaccurate or incomplete problem representation is a result of an ill-defined problem. Norman Frederiksen explains ill-defined, or ill-structured problems, in contrast to well-structured problems, as having at least three qualities: (1) they are more complex and have less definite

criteria for determining when the problem has been solved; (2) they do not come equipped with all the necessary information with which to solve the problem; and (3) they have no "legal move generator," or something to indicate all the possibilities at each step.

Processes for solving well- and ill-structured problems are basically the same, but for ill-structured problems (which include most writing tasks) a person's idea or conception of the problem changes gradually as new elements are invoked from long-term memory or other sources. Also, a "wide repertory of recognition processes is necessary to evaluate whether one is 'getting warmer' as a result of each altered state" (366).

Once the problem is at least initially represented, (though the representation may change with time), the next major part of solving comes into play: the search, or planning a solution.

Search:

Hayes says that problem solving can be thought of as a process in which the problem solver "searches through the problem space to find a solution path." If there are many "blind alleys" for each solution path, then we can expect the problem to be harder than if there are just a few blind alleys. Finding one needle hidden in a large haystack is probably going to be harder than finding the needle in a small haystack. But the size of the

space through which the problem solver must search is not as important as the method by which the search is conducted (Cognitive Psychology 183).

Search methods can lie anywhere on a continuum from simple to complex. "Trial and Error" search methods are fairly simple methods and may or may not in the long run be the most efficient (Problem Solver 30). Many novice writers attack a writing problem with trial-and-error methods, jotting down phrases and sentences as they occur to them, with no particular plan.

"Means-end" analysis is a more sophisticated method, and, consequentially, more powerful. The person employing means-end analysis uses an internalized means-end table in order to find a means which will reduce the distance to the end, or the goal (32). For instance, a writer trying to decide how to focus a topic for a paper might use a brainstorming technique, listing a variety of ways the paper could be focused. This technique may proved to be more efficient for the writer, who might otherwise write several drafts just trying to find a focus. Thus, the brainstorming serves as a means which reduces the distance to the end.

Fractionation is another search method which is very closely related to means-end analysis, but even more sophisticated, with less of the trial and error element. To apply the fractionation method, people break the problem into parts and use subgoals to guide themselves around the details. After breaking the problem into parts, they can drop a restriction, solve a sub-problem, then

add the restriction and fix it again. Many do this when faced with a writing task. Because it would be overwhelming to consider all the demands of the task at once, they break it into parts, such as research, brainstorming, organization, writing a rough draft, and revising (38-39), and work on one part at a time.

There are also knowledge-based search methods, of which algorithms are an example: knowing how to perform long-division entails having a formula that is guaranteed to solve the problem. But people can also learn patterns, which, while not algorithmic, may reduce the difficulty of the search (40). For instance, writers who have written a variety of letters-to-the-editor in the past can base their next letter-to-the-editor on patterns which they have probably internalized, thus reducing the difficulty of the search for the correct pattern.

Evaluating the Solution:

In addition to "problem representation" and "search," Hayes notes that evaluating the solution is an important part of the problem-solving process. He gives an example of evaluation which may strike a note with writing instructors. Sometimes, he says, people need an outside opinion, such as with writing:

Testing writing out on the audience for which it is intended is a very simple idea with obvious advantages, but very few people do it. Major corporations and governmental agencies put a great deal of money and effort into producing instruction manuals and other documents to inform the public, yet

rarely consider testing those documents on the audience for which they were intended. (48)

Hayes also notes the importance of consolidation, or reflecting on the problem-solving experience and learning from it. Consolidation can help people be more effective in solving future problems.

In summary, successful problem solving depends on a good problem representation (whether the problem is well- or ill-defined), a good search, or plan of solution, and a final evaluation of the solution.

Creativity

Creativity is a concept that often comes up in association with problem-solving, particularly when ill-structured problems are concerned. A person must possess elements of creativity in order to have the insight to solve an ill-defined problem. Frederiksen notes that theories of creativity are older than theories of problem solving, yet simplistic in comparison, because "creativity as such has so far received little attention from cognitive psychologists" (384). Frederiksen classifies theories of creativity into three groups:

(1) Stage Theories--the earliest stage theories were largely based on introspections of poets, scientists, and mathematicians. Helmholtz was one of the first to list stages, which were a) saturation, b) incubation, and c) illumination. Poincare (1952)

called the first step "preparation" and added a fourth step called "verification." Other theories have named "inspirational" and "elaborational" phases. Most of the stage theories imply that the subconscious part of the mind continues to work on the problem even when the conscious part of the mind doesn't. However, more recent studies have indicated that this hypothesis is not valid.

(2) Creative individual theories. Studies of creative people yield the information that research scientists have high energy levels, persistence, curiosity, and independence. Other creative people, such as architects, are self-confident, flexible, self-accepting, and not concerned much with the opinions of other people. Creative people also prefer complexity.

(3) Cognitive theories. These theories use more measurable factors in researching creativity, such as cognition, memory, divergent and convergent production, verbal comprehension, cognitive flexibility, and knowledge. One finding of this approach is that when problems are ill-structured, skill in retrieving information from long-term memory is important, along with reasoning (384-387).

John Hayes focuses on Frederiksen's third category, or cognitive theories, in his discussion of creativity. He says a creative act must satisfy two criteria: First, it must have "some valuable consequence." That is, the act must have an interesting or useful effect. Second, the creative act must be "novel and surprising." If we find it difficult to understand how the act

was performed, we are more likely to judge it creative (Cognitive Psychology 215-216).

Hayes tells us that four cognitive processes underlie creative acts, and we can see in these processes the parallels to the problem solving elements of problem representation and search indentified above. The processes are: (1) Problem finding, (2) Idea generation, (3) Planning, and (4) Preparation. Hayes notes that "extensive preparation is essential for acts of outstanding creativity." For instance, studies show that musical composers require about ten years of intense preparation before they are able to produce excellent works. He warns us that if a person is "basically lazy" and has decided to go into creative work, s/he has made a mistake, as creative people typically work 70-80 hours a week (Hayes, Problem Solver 199-215).

Summary

Cognitive psychology, a relatively new field of study, has helped researchers to make new, exciting observations about such things as human problem-solving behavior and creativity. Other disciplines are borrowing methods and findings of cognitive psychologists with which to make more observations. Composition theorists are participating in this discipline concept-transfer. Some of their findings will now be addressed.

CHAPTER III
RELATION OF PROBLEM-SOLVING THEORIES
TO COMPOSITION THEORIES

As indicated, research in the area of human problem solving is still in its infancy. Nevertheless, cognitive psychologists are discovering some exciting things about the way we solve problems, and other disciplines are borrowing some of their findings, terminology, and methodology, in order to explore new perspectives. Cognitive psychology's discoveries of human problem solving techniques seem to lend themselves to studies of the writing process, since the process of writing is an ill-defined problem.

The writing process is implied in Frederiksen's description (see Section II) of ill-structured problems. The well-known metaphor, "writing as discovery" (which, we shall see later, may have its disadvantages, but serves a purpose here), illustrates the fact that a person's idea or conception of the problem changes gradually as new elements are invoked. There are no algorithms for producing a well-polished essay. John Hayes notes that in order to solve ill-structured, or ill-defined problems, "we may have to make gap-filling decisions and we may have to jump into the problem before we understand it" (Problem Solver 22). Certainly this is true of the writing process.

It should not be surprising, then, that composition theorists and rhetoricians are studying the act of writing as a problem-solving process, using protocol analysis and other methodology/

terminology borrowed from cognitive psychology. This study of writing as a problem-solving process is different from using writing to solve problems, such as problems in business, society, and personal relationships, though both borrow from cognitive psychology. An brief discussion follows first of the latter concept (writing to solve problems), then a more detailed one of the former (writing as a problem-solving process).

Writing to Solve Problems

The idea that writing can and should be used as a tool for analyzing problems in society and other areas of daily life is discussed by Richard E. Young, Alton L. Becker, and Kenneth L. Pike in the now classic textbook: Rhetoric: Discovery and Change. An example of an assignment which stimulates problem-solving activity is found at the end of their chapter titled "Preparation: Identifying and Stating the Problem":

Spend the next fifteen minutes listing all the things in your immediate surroundings that clash in some way with features of your image; then state the problematic situations. Ask yourself why, if these situations are indeed problematic, you don't set about eliminating them. (100)

Clearly, this assignment is an example of using writing to analyze problems.

Many of Young, Becker, and Pike's statements about problem solving have become familiar, such as: "Problems do not exist

independent of men. There are no problems floating around in the world out there waiting to be discovered; there are only problems for someone." Further, problems come to the surface when there is an inconsistency, or a clash: "when a person becomes aware that two beliefs to which he is deeply committed are incompatible. . .when he discovers something in the nature of the world that doesn't 'fit' his conception of it." When a person becomes cognizant of such an inconsistency, s/he finds him/herself in a "problematic situation." The uneasy feeling that accompanies this awareness is part of the earliest stage of inquiry; ignoring it means that the process of inquiry may never begin (90-1).

Once a problem is recognized, it is important to make explicit the unknown in a complete statement, for the statement is "actually a partial description of the solution." (Recall that Hayes would classify this statement as "problem representation.") The statement acts as a guide to inquiry and also helps us to know when we have found our solution. Sometimes a problem may actually be a cluster of "subordinate" problems, which individually must be solved in order for the larger one to be completely solved. A well-stated unknown, then, "serves as an instruction for effective investigation. It defines what is sought and guides but does not construct inquiry" (92-96).

It is obvious that Young, Becker, and Pike's chapter on identifying and stating problems through writing borrows concepts from cognitive psychology. Richard Larson, in "Problem-solving,

Composing, and Liberal Education," published just two years after the Young, Becker, and Pike text, also suggests that methods derived from cognitive psychology can be used in writing to solve problems that people face in society. Problem-solving, he says, is a way for a student to plan arguments on complex issues. It is also a technique for reflecting on experience; for discovering judgements, values, and desirable actions; and for evaluating the contentions of others. If instructors of writing claim that their courses "are more than laboratory sessions on linguistic and social conformity," and if instructors believe that their classes "have a place in the liberal studies curriculum more honorable than that of servant to other disciplines," then teaching problem-solving techniques may be of benefit (635).

The problem-solving process relates to writing in two ways: it is "at once an activity of mind and a principle of form capable of organizing expository or argumentative writing." As an activity of the mind, problem solving "represents an organized way of confronting and dealing with issues and data--a way that psychologists say is characteristic of many persons we think of as 'creative.'" As a principle of form, the writer can carry on "a systematic inquiry into his subject, using a controlled procedure that dependably yields reasonable conclusions. The rhetorical medium, in effect, is a major part of the message; it operates as a form of ethical proof" (632). Larson's words, "activity of the mind," pave the way for what comes later in the 1970s: the study

of writing as a problem-solving process, with guided inquiry into the cognitive processes of the human mind.

Writing as a Problem-Solving Process

In 1971, Janet Emig published The Composing Processes of Twelfth Graders, and this monograph was the first effort to address "the texture of the composing experience." Emig's text has caused an "explosion of research on composing processes in the last decade" (Lunsford 155). Her monograph, which uses case studies of high school seniors in order to study the writing process,

seems to have established a new emphasis in scholarship on composition that others willingly continued: an emphasis on addressing the texture of the composing experience, on what practicing writers do when they write, on how (insofar as one can get at the subject) their minds work. (Larson, "Recent Research" 244)

Linda Flower has extended Emig's study of the writing process, attempting "what are easily the most comprehensive studies of the composing experience" (244). Shortly after Emig's seminal text, Linda Flower and John Hayes published "Problem-Solving Strategies and the Writing Process" (1977). This article was the first, at least in the field of composition, to put forward a theory of writing as a problem-solving process and to study it as such. Flower and Hayes note that what many

instructors teach in the classroom about writing does not adequately cover the subject. Within the classroom,

writing appears to be a set of rules and models for the correct arrangement of preexistent ideas. In contrast, outside of school, in private life and professions, writing is a highly goal-oriented, intellectual performance. It is both a strategic action and a thinking problem. (449)

Flower and Hayes discuss problem solving as a new area in cognitive psychology, one which has a "well-developed method for studying thought processes." They wish to study writing as a form of problem solving. That is, the activity of writing anything, whether a problem-solving paper, a short story, a poem, or an informational essay, is an activity composed of problem-solving strategies. Flower and Hayes, in their study of writing as a problem-solving activity, wish to discover and describe "some of the basic heuristic procedures which underlie writing, and then to translate these heuristics into teachable techniques" (450). A discussion of the heuristics that Flower and Hayes, and others, have identified will appear in Chapter VI, after the following review of the research on the cognitive processes of writing which has accumulated since the late 1970s.

CHAPTER IV
COGNITIVE STUDIES
OF THE WRITING PROCESS

Overview

As indicated, there has been a proliferation of research into the cognitive processes of writing since Janet Emig's and Flower and Hayes' ground-breaking works. Flower and Hayes particularly, in their identification of writing as a problem-solving process, have opened up a new way of learning about the writing process--a more empirical, scientific way. The approach offends many in this humanistic profession who are accustomed to more intuitive ways of thinking about writing. But cognitive studies of the writing process, while we may not want to embrace them unconditionally, may tell us things we don't know; or, they may confirm empirically what our intuitions have told us is true.

Scardamalia and Bereiter call the cognitive science approach "the only paradigm in town for investigating complex mental processes, which all sides agree are of central concern in writing." In fact, they pinpoint nine different strands of research in composition that have emerged within the cognitive framework in the last decade, the most important of which for our purposes here is research on the composing process itself. This work has resulted in a "fairly coherent description of mental processes that go on in writing" ("Research" 780).

The efforts of cognitive theorists in investigating the writing process can be categorized into at least three major groups.

First, Flower and Hayes offer a cognitive model of the composing process, which divides the writer's world into three parts: the task environment, the writer's long-term memory, and the writing process. (This model will be discussed shortly.) Their model and research "provides us with extremely valuable information on how writers set goals, how they solve problems, and how they represent meaning to themselves" (Andrea Lunsford 155).

Second, Bereiter and Scardemalia incorporate Flower and Hayes' model, along with models of speech production and of language comprehension in order to advance a tentative model of "stages in writing development." According to Lunsford, this model is "even more tentative" than that of Flower and Hayes, and "more seriously flawed." However, the model "focuses our attention not only on describing the process but on relating that process to instruction as it may or may not aid development of writing ability" (156-157).

The goal of Bracewell, Frederiksen, and Frederiksen, the third group of researchers, is to "develop a unified theory of discourse production (writing) and comprehension (reading)." Further, by linking the cognitive processes common to both reading and writing, Bracewell et al. move toward a more general model of cognition and communication (157).

Research by all three groups, while "tentative and evolving," emphasizes "questions of process and representation and attempts to develop models that would identify and define the cognitive processes involved in reading and writing" (Lundsford 157).

It is important to recognize that identifying certain strategies that can be taught from various models is certainly as important, if not more so, than identifying the stages or models themselves. However, as necessary background, there follows a detailed discussion of the Flower and Hayes composing process model, from which many of the most important pedagogical strategies have been gleaned (see Chapter VI). Theories of other researchers will be covered as well, usually in the context of the Flower and Hayes model.

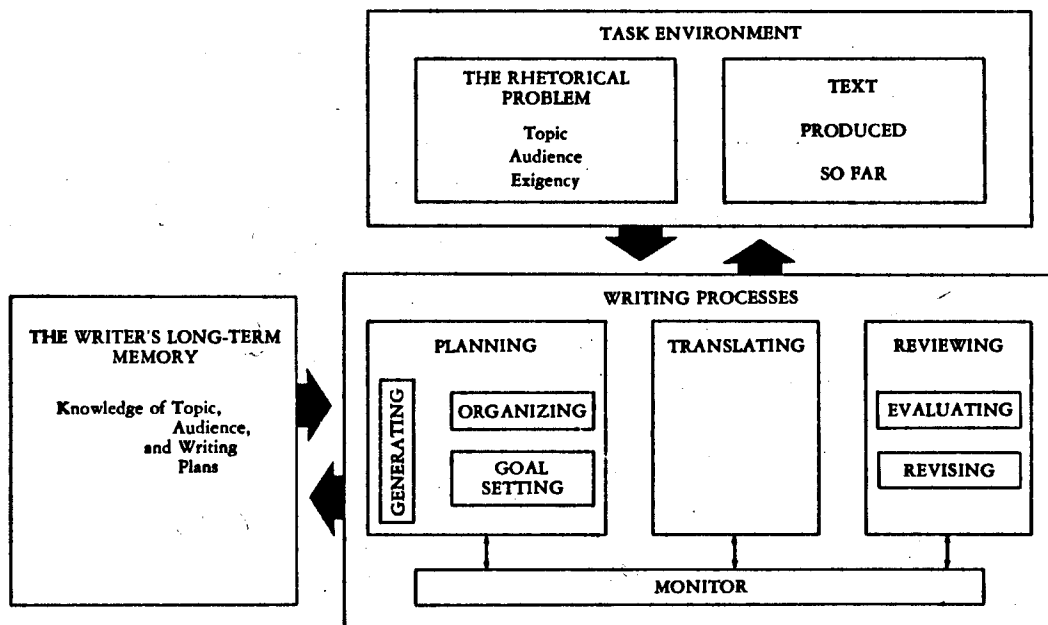
The Act of Writing: A Cognitive Process Model

To date, the most extensive cognitive process model for writing is that developed by Flower and Hayes ("Identifying the Organization of Writing Processes," 1980; and "A Cognitive Process Theory of Writing," 1981). Elements of this model are presented below, along with pertinent research by other theorists.

Flower and Hayes' "Structure of the Writing Model" appears below. We must first understand that the multiple arrows in the diagram indicate only that information flows from one box to another, not that "such information flows in a predictable left to right circuit, from one box to another as if the diagram were a

Structure of the Writing Model

(From: Flower, Linda, and John R. Hayes. "A Cognitive Process Theory of Writing." College Composition and Communication 32 (1981): 365-386.



one-way flow chart." A flow chart would imply a stage model, which is not the intent, for the writing process can not be orchestrated in a linear series of stages ("Cognitive Process" 386-7).

The model is based on four key assumptions:

1. The process of writing is best understood as a set of distinctive thinking processes which writers orchestrate or organize during the act of composing.
2. These processes have a hierarchical, highly embedded organization in which any given process can be embedded within any other.
3. The act of composing itself is a goal-directed thinking process, guided by the writer's own growing network of goals.
4. Writers create their own goals in two key ways: by generating both high-level goals and supporting sub-goals which embody the writer's developing sense of purpose, and then, at times, by changing major goals or even establishing entirely new ones based on what has been learned in the act of learning. (366)

In their attempts to develop their model, Flower and Hayes have focused on determining differences between "novice" and "expert" writers.

As the model illustrates, the act of writing involves three major elements: the task environment ("all the things outside the writer's skin, starting with the rhetorical problem or assignment and eventually including the growing text itself"); the writer's long-term memory ("in which the writer has stored knowledge, not only of the topic, but of the audience and of various writing

plans"); and the writing processes ("specifically the basic processes of Planning, Translating, and Reviewing, which are under the control of a Monitor") (369). Following is a discussion of these elements.

The Task Environment

The task environment consists of the rhetorical problem and the growing text itself. Defining the rhetorical problem, which is composed of (1) the rhetorical situation (topic), (2) audience, and (3) the writer's own goals (exigency), is a major part of the writing process. However, writers often reduce a rhetorical problem to a simplistic level, such as "write another theme for English class." Such ill-defined (or "under-developed") rhetorical problems are unlikely to be "solved" by the writer because the right questions cannot be addressed.

The act of internally formulating questions is called "problem finding" by some, but Flower and Hayes say it is "more accurate to say that writers build or represent such a problem to themselves, rather than 'find it.'" A rhetorical problem is never something a person discovers; rather, "it is an elaborate construction which the writer creates in the act of composing." Thus, Flower and Hayes caution against limiting writing to the metaphor, "writing as discovery," because it implies that "hidden stores of insight and ready-made ideas exist, buried in the mind

of the writer, waiting only to be 'discovered'" ("Cognition of Discovery" 21-22).

Flower and Hayes have used protocol analyses of novice and expert writers to arrive inductively at a list of "the basic elements of a writing problem which a given writer could actively consider in the process of composing, if he or she chose to:

THE RHETORICAL PROBLEM

<u>Elements of the Problem</u>	<u>Protocol Examples</u>
The Rhetorical Situation: Exigency or Assignment	"Write for Seventeen magazine; this is impossible."
Audience	"Someone like myself, but adjust for twenty years."
The Writer's Own Goals involving the:	
Reader	"I'll change their notion of English teachers..."
Persona or Self	"I'll look like an idiot if I say..."
Meaning	"So if I compare those two attitudes..."
Text	"First we'll want an introduction." (24)

Flower and Hayes note that these elements closely parallel the four terms of the communication triangle, which are: reader, writer, world, and word.

Flower and Hayes' protocol analyses show that one of the big differences between novice and expert writers is how many elements of the rhetorical problem they consider and "how thoroughly they represent any aspect of it to themselves." (Recall Hayes' statement in Chapter II that problem representation is one of the major activities employed in solving problems.) Further, it has become apparent that experienced writers have more "stored representations" of complex rhetorical problems (24-25). That is, when faced with a particular rhetorical situation, such as "Write an analysis of a newspaper article," experienced writers can draw upon prior writing activities that engaged in similar analyses, which help them with the present writing activity. (This strategy is also known as a "knowledge-based search method," as discussed in Chapter II.)

In addition to responding to more elements of the rhetorical problem, Flower and Hayes note that good writers "create a particularly rich network of goals for affecting the reader." Also, good writers continue to more specifically develop their image of the reader and other elements as they write. However, poor writers often stick with a poorly developed problem representation with which they started, and in general do not change their conception of the audience or other rhetorical concerns. Consequently, "good writers are simply solving a different (rhetorical) problem than poor writers" (30).

Along these same lines, Scardamalia and Bereiter suggest that novice writers such as elementary and secondary students don't even give themselves problems to solve when writing for an assignment. Employing a strategy called "knowledge telling," these novice students reduce writing assignments to "topics," then tell what they know about the topic. Since this strategy does not involve explicitly formulating goals and representations for the text, it "has the effect of eliminating much of the problem solving observed in expert composing" ("Assimilative Processes 165). One reason for knowledge-telling behavior could be that most instruction in writing encourages the perfection of the knowledge-telling strategy. Is it possible, ask Scardamalia and Bereiter, that "knowledge-telling strategy is reserved for ordinary school tasks that students perceive as pointless and that other strategies are available to them when a more personal goal exists?" (167)

However, the reason for knowledge-telling behavior is probably more complex than inadequate assignments. Goals are a form of knowledge, but that goal-related knowledge seems to come rather late in writing development--later than other forms of knowledge. Thus, a high school student may have a knowledge of a subject, enough to produce a five-paragraph theme, but may not have the kind of knowledge associated with goals that could help him/her write a more meaningful essay. The instructor's job is seen as helping students learn how to assimilate externally-

assigned tasks to meaningful goals of their own (169-70).

We can see, then, that responding to the rhetorical problem is in itself a complex set of tasks, involving the rhetorical situation, audience, and the writer's own goals.

The second element in the task environment is "the written text." Largely unexplored by process-oriented cognitive researchers such as Flower and Hayes, the written text is an element which places even more constraints upon the writer. "Just as a title constrains the content of a paper and a topic sentence shapes the options of a paragraph, each word in the growing text determines and limits the choices of what can come next" (Flower and Hayes, "Cognitive Process" 371).

In addition to the growing text, the writer's knowledge stored in long-term memory and the writer's plans for dealing with the rhetorical problem also direct the composing process.

The Writer's Long-Term Memory

The writer's long-term memory can exist not only in the mind, but also in outside resources, such as books. The long-term memory "is a storehouse of knowledge about the topic and audience, as well as knowledge of writing plans and problem representations." Sometimes an assignment, such as to write something persuasive, can have a single cue which causes a writer to remember "a stored representation" of a previous problem, thus

bringing a whole set of writing plans into play ("Cognitive Process" 371).

Use of long-term memory, a "relatively stable entity" with its own internal organization, may pose two problems. One problem can be retrieving things out of it, which entails finding the cue which will let a network of useful knowledge be retrieved. The second problem is reshaping the information retrieved to "fit the demands of the rhetorical problem" (371).

The phenomenon of "Writer-Based" prose is an example of a writing strategy based on memory retrieval, with no adaptation for the rhetorical problem. Writer-based prose is organized so that it "faithfully reflects the writer's own discovery process and the structure of the remembered information itself," but it fails to make the transformation or reorganization which is necessary to meet the needs of the reader (371-2). Obviously, the writer must be able to shape or adapt the information from long-term memory in order to serve the reader's needs.

The Writing Process

The final major element in the writing model is called "the writing processes," which Flower and Hayes break into further groups: planning (with sub-categories of "generating," "organizing," and "goal setting"), translating, reviewing (with the sub-categories, "evaluating" and "revising"), and the monitor. It is crucial to remember that the writing process is not linear,

with progression from one stage to another; rather, the writer juggles the elements of planning, translating, and reviewing at the same time, or slips from one to another and then back again.

Planning:

Planning is one of the most powerful heuristic procedures because it can reduce a large problem to manageable size. (Recall that planning a solution is discussed as "Search" in Chapter II, and that search methods range from simple, trial-and-error methods, to more complex methods, such as "means-end" or "fractionation.") In fact, the ways writers coordinate their various plans "affect the efficiency of their composing processes and the effectiveness of their final products (Flower and Hayes "Plans" 39).

While composing, expert writers use a variety of fractionated plans: "plans for generating ideas" (generating), "plans for producing a paper" (organizing), and "plans which guide the composing process itself" (goal setting) ("Plans" 42). In another article, Flower and Hayes call these three categories, "plans to say," "plans to do," and "composing plans" ("Dynamics" 44). The latter categories will be used for further discussion.

Plans to say: Within the category of plans for generating ideas ("plans to say"), writers make "procedural plans" and "content-specific" plans. An example of a good procedural plan

might be, "I'm just going to jot things down as they occur to me," or "I'll worry about the spelling later." A less defined plan, and consequently less effective one, might be, "I'll just kind of follow things along." These procedural plans are "content-free decisions about how to control. . . idea-generating activities." An advantage of good plans is that they help a writer to keep focused on high-level goals, such as developing a broad set of ideas (42-43).

Most idea-generating plans, however, are "content-specific, acting on the information available immediately to the writer." Flower and Hayes identify four content-specific plans exhibited by their student writers:

1. Pursuing an Interesting Feature. Here, a writer explores an interesting word, idea, or event by using various "generating techniques," such as searching memory, drawing inferences, and reasoning from examples. This exploration leads to more complex processes.
2. Thinking by conflict. Here, the writer either asks him/herself specifically to find a contradiction and pose questions, or more globally, the writer may seek out conflicts in his/her own thinking, or between ideas/intuitions/commonly held notions. An example is writing parallel columns of pros and cons as an aid in deciding what to include in an essay.
3. Saying What I Really Mean, or WIRMI: "What I Really Mean Is..." WIRMI is a plan writers use when they want to reduce a body of complex information to its essential features.
4. Finding a Focus. The protocols showed that writers don't start with a focus. Instead, they start with knowledge and goals, and create their

focus. "Creating a focus is one of the crucial acts that can bridge the gap between generating ideas and turning them into a paper; it is also a task with which many writers have trouble." Many writers feel they can discover a "ready-made" focus if they search their memories long enough, rather than try to create a focus. (Paraphrase from 44-45)

Plans to do: The second category of plans that Flower and Hayes identify is "plans for producing a paper" (or "plans to do"). This category also features both procedural plans and content-specific plans. A procedural plan might be something like, "I'll make an outline," or "Let's try and write something." Some content-specific plans include:

1. Forming for Use. Here, the writer pulls an idea out of her/his original context and reshapes it for the written text.
2. Organizing. Organizing includes a global plan for finding a focus, but also subplans for organizing sections of the paper.
3. Reader-Based Plans. Here, writers consider the audience and develop strategies based on "what the reader might assume, object to, or need to know." Sometimes writers do this by playing the role of the audience to themselves. (As mentioned above, many writers ignore this aspect of the rhetorical situation and consequently produce writer-based prose.)
4. Product-Based Plans. An example of a product-based plan is "Here's an interesting point. I think I'll write a paragraph on this." Product-based plans occur "when the composing process is governed by a concern for the form of the finished product." A product-based plan, if employed too early in the writing process, may place too many "rigid constraints" on the writer and "thwart the dynamics of the normal generating process." (47-51)

Composing plans: The first two categories of plans--"plans to say," and "plans to do"--interact in the third category of "composing plans," or plans controlling the composing act. There are at least three sorts of interaction. One is "switching plans." Major switches come when writers run into difficulty. Another is "mapping plans onto one another." One plan may be superimposed upon another, or may dictate the formation of the second. A final interaction is "conflict between plans." A writer may change a plan in favor of another, sometimes to the detriment of the final products. An example of conflict between plans is:

Pat finally entered in a very productive session of brainstorming, generating a series of ideas and examples that proved her point. Then suddenly in the middle, she broke off brainstorming with the comment, "I'm just listing things. This is a rip." . . . And yet, these are some of the activities which are essential to thoughtful and creative generation. (51-55)

While juggling all these types of plans can be difficult, "working without plans can be more difficult still." Procedural plans such as the ones described above are not "mysterious or difficult," but they do entail a knowledge or consciousness about the thinking/working process of writing and "an awareness of the useful techniques writers use" (56-57).

In conjunction with their earlier-described work on "knowledge-telling," Scardamalia and Bereiter maintain that

formulating plans and goals is a form of knowledge, a competency that children and novice writers just might not have yet:

The general pragmatic abilities of children permit them to formulate plans for getting to already-identified and fixed goals. They do not equip them to engage in reflective planning, where goals take shape through the planning process.

Further, a reflective planner transforms the writing task into one of higher complexity, but the knowledge-teller, or novice writer, transforms the task into one of lower complexity ("Assimilative 168).

Skillful, or reflective planning, is often "opportunistic," a word employed originally by Barbara and Frederick Hayes-Roth ("A Cognitive Model of Planning"). "Opportunistic" means that the writer/planner recognizes when the "attainment of one subgoal creates the opportunity for attaining another, and so he chooses and arranges subgoals accordingly." Since opportunities are often discovered in the course of writing, planning goes on throughout the composing process. Even top-level goals may be changed in the course of writing and be subsumed by other goals:

Compositions often turn out in ways unanticipated by the writer, but this is not an indication of planlessness. Rather it is an indication of a very dynamic planning process that keeps adjusting decisions at every level in the light of decisions made at other levels. (Scardamalia and Bereiter, "Recent Research" 789)

In summary, at least three major categories of plans can be ascertained. They are "plans to say," "plans to do," and "composing plans." Plans must be changed from ideas into written language in order to be useful for the writer. This is accomplished through the act of translating, which will be discussed next.

Translating:

Translating is "the process of putting ideas into visible language." Information produced in planning may be represented in key words or symbol systems other than language, such as imagery. The writer must translate meaning, stored in key words or imagery, into a "linear piece of written English" (Flower and Hayes, "Cognitive Process" 373).

The process of translating requires the writer to juggle a variety of demands of written English, which lie "on a spectrum from generic and formal demands through syntactic and lexical ones down to the motor tasks of forming letters." For children and novice writers, "the extra burden may overwhelm the limited capacity of short-term memory." Even so, considering the limited capacities of any of us--novice or expert writers--it is remarkable that we are able to deal with the following activities simultaneously in writing, as Carl Bereiter points out:

"handwriting, spelling, punctuation, word choice, syntax, textual

connections, purpose, organization, clarity, rhythm, euphony, the possible reactions of various possible readers, and so on" ("Development in Writing 80).

Like "the written text," the element of "translating" is one largely unexplored by composition theorists, probably because of the lack of information available from protocol analysis. The next element, however, which is "reviewing," has been the focus of extensive research.

Reviewing:

Flower and Hayes' model of "reviewing" includes two elements: "evaluating" and "revising." As discussed in Chapter II, evaluating is an important element in the problem-solving process. A positive evaluation, or judgement, usually leads the writer back into "planning" or "translating." A negative evaluation, however, leads the writer into "revising." Flower and Hayes have recently collaborated with other researchers to further expand knowledge of "revising." Their more recent findings are published in at least two articles: "Diagnosis in Revision: The Expert's Opinion" (1985); and "Detection, Diagnosis, and the Strategies of Revision" (1986). Since both articles are extremely lengthy, only a brief review of their findings is possible here.

Research suggests that the revision processes of experienced and novice writers differ because they bring different assumptions and language to the task. Some students face revision

like the grim reaper, prepared to tramp through a text cutting and "slashing out." The goal, as they describe it, is to fix errors rather than rethink; the primary tool is deletion. In contrast, many experienced writers conceptualize the task as discovering content, structure, and voice. ("Detection" 17)

Another difference between experienced and novice writers is that experienced writers make a good share of their revisions after rereading their drafts, while poor writers make most of their changes as they are writing. Flower and Hayes suspect that the better writers are using rereading to "construct a sense of the text's current gist and/or to form a rhetorical plan" to guide revision. Yet another difference between experts and novices is that "novices typically focus on convention and rule-governed features," or "surface features," while experts use revisions to alter meaning more often (17-18).

Flower and Hayes point out that our current idea of revision is as an "extended, discovery-based process (which) reflects the habits of the novelists, journalists, essayists, and academicians usually studied." However, studies of writers in business settings show many "first-time-final drafts." Instructors assume that revisions make better papers, but:

The amount of revision is simply not the key variable. . . . revision as an obligatory stage required by teachers doesn't necessarily produce improvement, especially if the writer has put effort into the planning and writing. Revision, then, is a strategic action, adapted to the necessities of the task. (18)

Scardamalia and Bereiter prefer the term "reprocessing" when discussing revision. They say "revision is a special case of reprocessing, applied to actual text." However, there can be "internal revision," where writers try to discover and develop what they have to say even before they write anything down ("Research" 790).

Along those lines, Stephen Witte, author of "Revising, Composition Theory, and Research Design," says that internal revision, or what he calls "pre-textual" revision, has been neglected by researchers. He feels that the concept of revising should include not only retranscribing but also revising a pre-text, which is a "mental representation" that can take "multiple forms--from sensory images, to concepts, to metaphors, to feelings" (264). Witte suggests that many writers revise their pre-texts extensively, even before anything is written down. He grants that the Flower and Hayes model leaves room for investigating pre-textual revision within its framework, but suggests that researchers in general have ignored this important area (278).

The Monitor:

As indicated by its name, the monitor "functions as a writing strategist which determines when the writer moves from one process to the next" (Flower and Hayes, "Cognitive Process" 374). Thus, while writers write, they also monitor their process, deciding

such things as how long to brainstorm for ideas, when to start writing, and when to evaluate. Decisions made by the monitor are influenced by the writer's goals and by his/her writing habits or styles (374).

Summary of the Act of Writing Model

The structure of Flower and Hayes' writing model, as indicated, consists of the task environment (which includes the rhetorical problem and the text produced so far); the writer's long-term memory; and the writing processes of planning (generating, or "plans to say," organizing, or "plans to do," and goal setting, or "composing plans"), translating, and reviewing (evaluating and revising); and the monitor. Certain elements of the model, such as planning and revising, have been researched more extensively than others. Many researchers are now beginning to investigate unexplored elements of the model and beyond. Some of their findings will now be discussed.

Beyond the Act-of-Writing Model

Flower and Hayes have consistently reminded readers that their model of the act of writing is a tentative one. Other researchers have branched into areas unexplored by the model, many with support and encouragement from Flower and Hayes. Some of these areas have been those of pre-text, writer's block, the affective element, and an account of reading along with writing.

Pre-text

Witte, mentioned above, is one example of a researcher attempting to expand knowledge of the Flower and Hayes model. Since the publication of his article on revising, Witte has written "Pre-Text and Composing," in which he expands his concept of "pre-text" and associates it with other processes in addition to revision. "Pre-text" refers, he says, to a writer's linguistic representation of intended meaning. This meaning is tentative, a "trial locution" produced in the mind, stored in the writer's memory, and sometimes manipulated mentally before being transcribed as written text. In this article, Witte confines pre-text to semantic and syntactic components, such as phrases, dependent clauses, sentences, or sentence sequences. Pre-texts differ from more abstract plans like nonverbal images in that pre-texts approximate written prose. A pre-text represents "the writer's attempt to instantiate abstract plans and goals in linguistic forms." Pre-texts are "the last cheap gas" before writers commit themselves to extended written text" (397-98).

Witte has considerably modified his original definition of pre-text in this article. He now feels that pre-texts "represent critical points along a continuum of composing activities between planning and transcribing written text" (397). Thus, pre-texts are critical not only to revision, but other elements of the writing process as well.

Witte poses four observations about the "nature and function" of pre-text during composing: (1) Pre-text may have direct influence on written and unwritten text; (2) Pre-text may be stored in memory in such a way that it may have a delayed, but direct, effect on the written text; (3) Evaluating and revising pre-text stored in memory can be based on criteria used to evaluate and revise written text; and (4) Pre-text can function as a critical link among written text, translating ideas into linguistic form, and transcribing ideas into visible language (417).

Witte gives credit to Flower and Hayes, as well as Scardamalia and Bereiter, for implying in their research the possibilities of pre-text, but considers his research to be further exploration of this largely ignored concept. Thus, his work can be seen as an expansion of the Flower and Hayes model.

Writer's Block

Another researcher attempting to expand the Flower and Hayes model is Mike Rose. Rose investigates the cognitive dimension of the writing process for answers to the reasons for writer's block, which he suggests is "one of the least studied dysfunctions of the composing process" (Writer's Block 1). He defines writer's block as "an inability to begin or continue writing for reasons other than a lack of basic skill or commitment" (3).

Rose feels that the Flower and Hayes model is "the most detailed, multioperational, and comprehensive of composing models constructed to date." However, he criticizes the model for its lack of "fluidity." Rose says the model has a "top down, hierarchically deductive perspective," which views the writer as working in sequential way from, for instance, generation of ideas sentence-production. Although Flower and Hayes admit that writing is recursive and pose the notion of "priority interrupts," Rose feels that "recursiveness" and "priority interrupts" could be represented in a less mechanical way (8). These concepts, he feels, are better represented by the label "opportunism." As discussed earlier, opportunism suggests that attainment of one subgoal creates the opportunity for attaining another, thus subgoals are chosen and arranged accordingly. Sometimes these decisions follow orderly paths, but sometimes the path for plan development is disorderly.

Rose feels that the application of opportunism to writing suggests that the goals, plans, discourse frames, and information that must be juggled as a writer confronts a task are not always hierarchically sequenced from most general to most specific. These goals and plans can influence each other in a variety of ways. For example:

While editing a paragraph, a writer may see that material can be organized in a different way or as a writer writes a certain phrase, it could cue other information stored in memory.

Rose says his scheme is not a complete model, but a "metaphorical representation" that highlights parts of the composing process relevant to his study, which is "the relation of writing to high-level strategies and general problem-solving/composing orientations, and to rules, plans, and discourse frames" (8-10).

Working within this framework, Rose suggests some possible reasons for writer's block:

1. The rules writers use for guiding their composing processes may be "rigid, inappropriately invoked, or incorrect."
2. Writers' assumptions about composing may be misleading.
3. Writers may edit too early in the composing process.
4. Writers may "lack appropriate planning and discourse strategies or rely on inflexible or inappropriate strategies."
5. Writers may try to invoke "conflicting rules, assumptions, plans, and strategies."
6. Writers may evaluated their writing with inappropriate criteria." (Paraphrase from 3-4)

The model, or scheme, that Rose works with, then, is the combination of the Flower and Hayes model and the concept of opportunism. Some of Rose's implications for instruction about writer's block will be discussed in Chapter VI.

The Affective Element in the Writing Process

Because the Flower and Hayes model explores cognitive variables to the virtual exclusion of affective variables, one focus of recent research has been devoted to this possible gap in the "Act of Writing" model. Alice Brand has been particularly vocal about the exclusion of the affective/emotional element in the writing process. Two recent articles address this exclusion: "Hot cognition: Emotion and Writing Behavior" and "The Why of Cognition: Emotion and the Writing Process" (1987).

"Hot cognition," says Brand, is essentially "cognition colored by feeling." What cognitive psychology needs is "some way to heat up cognition--a theory that unites the cognitively blind but arousing system of affect with the subtle cognitive apparatus ("Hot Cognition" 1985, 1). Cognitive researchers have not admitted that "the problem solving that we associate with conscious cognizing often relies on less-than-conscious, intuitive, or prelogical thought" (4).

Consequently, says Brand, motivation and emotions such as "apathy, anxiety, disequilibrium, alienation, despair, and commitment" are "tucked into corners of work by James Britton and by Linda Flower and John Hayes to be pulled out when other explanations fail," even though affect is "repeatedly implicated" in major human development theories like those of Jean Piaget ("The Why of Cognition" 438). Brand feels that the cognitive process model of Flower and Hayes "provides no language to deal

with emotion." Because of this lack of affective language, Brand is concerned about what the model suggests about people:

The cognitive notions of monitors and Operators are not people but incorporeal automatons. Disembodied Editors, not humans, detect flaws. Disembodied Inspectors evaluate performance. These entities have decision-making powers through us, but they are not us. We are circuits. We are transitors, fire alarms, smoke detectors, switching yards, semaphore signals, radar, and PC's. (440)

This approach, says Brand, encourages writing instructors to assume that students should behave like the model, assuming a "flat, uncomplicated objectivity," with no allowance for emotional and/or motivational factors. Brand suggests that it is time for cognitive theorists to add the "why of writing" to their investigation of the "how of writing," in order to make the theories more complete.

Susan McLeod ("Some Thoughts about Feelings: The Affective Domain and the Writing Process," 1987) offers a tentative theory which fuses the affective element with a problem-solving view of the writing process. She says that the "constructivist" views offered by George Mandler in Mind and Body are compatible with the cognitive theories by Flower and Hayes. Mandler asserts that "emotional experience consists of two factors, one physiological, the other cognitive." When an emotion occurs, the automatic nervous system is activated and results in a response, such as "the familiar 'gut' response: a knot in the stomach, a quickened

pulse, a heightened awareness of external stimuli." Our cognitive response is to make sense of this physical agitation, evaluating it either positively or negatively.

Mandler says that a major source of emotion is "the interruption of an individual's plans or planned behavior, plans which have a tendency toward completion." Thus, completing something interrupted is a "positive, even a joyful experience." McLeod connects this idea to Flower and Hayes' explanation of "planning." Flower and Hayes say that plans are interrupted "with disturbing frequency" by various constraints, so that goals and strategies must be defined and redefined as writers write. So, says McLeod, "interruption of plans, a major reason for emotions to occur, is integral to the writing process. If we agree with Mandler, we must admit that it is impossible to write without some emotion occurring" (431-2).

While some writers interpret their agitation resulting from interrupted plans as negative ("anxious, frustrated, blocked"), others interpret their agitation as positive ("the excitement of the chase"). Mandler's theory helps us to understand why students may be reluctant to revise their written work: "The 'joy of completion' which comes when an interrupted action is finally completed is to them a signal of closure." Thus, the problem solver relaxes and feels finished, even if the final solution is inadequate (432).

McLeod suggests that writing anxiety, motivation, and student beliefs about writing can all be studied within this framework which unites the affective and cognitive domains, thus at least partially answering Alice Brand's call for a "hot cognition" approach.

An Account of Writing and Reading

Another area possibly not covered by the Flower and Hayes model is the link between discourse production and comprehension, or between writing and reading. Bracewell, Frederiksen, and Frederiksen say that research in literacy normally investigates either reading or writing:

This split is characteristic both of theoretical and empirical research and of instruction in the language arts, even though one feels intuitively that reading and writing comprise aspects of the same underlying literacy skills. (146)

Further, in oral communication, comprehension and production usually are mixed. Bracewell et al. reason that a theory of the development of literacy skills needs to treat both the process of comprehension and production. Thus, their efforts are toward a "unified and informative comparison of comprehension and composing processes" (147).

Central to this approach are two categories of discourse processing: "framing" and "regulating." Framing processes

produce a structure, or frame, for the text. Thus, framing is closely tied to the "planning" element in Flower and Hayes' model. An example might be a child's writing that lacks a conceptual frame that would make the fiction a story, rather than an event sequence:

A monster comes down to earth, and climbs down the ladder of the spaceship, and speeds away in a supercharged car, and sees a witch, and kills her with a laser gun, and then. . . . (151)

Regulating processes "access language structure, translate conceptual structure into a text for production, and regulate construction of the conceptual structure for comprehension" (146). Regulating processes affect such things as flow, openings, closing, and topic shifts. Research done by Bracewell et al. shows that framing and regulating processes are involved in both production and comprehension; thus, their research links the two processes in its study of discourse processes.

Bracewell et al. give credence to the Flower and Hayes model, saying that their research is an attempt to explicate the relationships within the model, and expand the focus to comprehension as well as production (151).

Stephen Kucer also explores the relationship between reading and writing, using some of the terminology put forth by Flower and Hayes. Kucer states it is unlikely that "language users have two completely different and independent sets of cognitive mechanisms

for reading and writing" ("The Making of Meaning" 319). Rather, since both acts are "acts of meaning-making" (318), they probably share similar cognitive mechanisms, such as long-term memory, goals, plans, and strategies (320-328). Kucer suggests that by establishing such "cognitive basics" as those just listed, teachers should be able to develop literacy curricula which integrates reading and writing instruction (332-3).

Section Summary

In 1985, Lester Faigley et al. (Assessing Writers' Knowledge and Processes of Composing) suggested that a new generation of cognitive research would be centered on issues raised in reaction to the Flower and Hayes model. The new research would need to center on such things as the degree to which individuals vary in composing; the degree to which writing is the reverse process of reading; the nature and scale of components in composing, and the relationships among them; where "bottlenecks" occur in writing and what causes "blocks"; and how learning occurs (8-9). The above-described research by Stephen Witte, Mike Rose, Susan McLeod, and Bracewell, Frederiksen and Frederiksen, seems to be a product of that new generation of researchers. What these researchers have in common, along with Flower and Hayes and Scardamalia and Bereiter, is the fact that they are all working within the cognitive framework of investigation.

There are, however, other researchers and theorists who disagree not only with the methodology, particularly protocol analysis, of the cognitive researchers, but also with using the cognitive framework to investigate the writing process. Some of their concerns will now be addressed.

CHAPTER V
ISSUES IN
COGNITIVE RESEARCH ON THE WRITING PROCESS

Dissent among composition theorists and rhetoricians regarding cognitive research seems to revolve around (1) the validity of protocol analysis and (2) the validity of the cognitive framework for studying writing. Many dissenters, even under article titles linked to a critique of protocol analysis, largely wind up criticizing the theory behind the method, rather than the method itself. However, here the two facets will be addressed individually.

Protocol Analysis

Despite strong evidence that under certain situations protocol analysis is a valuable tool for collecting data about mental processes, the method is often criticized. Protocol analysis is "a description of the activities, ordered in time, in which a subject engages while performing a task" (Hayes, Problem Solver 51). Three basic kinds of protocols are used by cognitive researchers to describe psychological processes. They are "motor protocols," (observers note such activities of the subject as walking and picking things up); "eye-movement protocols," (observers note where subjects fix their gaze as they perform tasks); and "verbal protocols" (subjects are asked to say aloud everything they think while performing a task, whether or

not it seems trivial to them (52-53). Verbal protocols are most widely used by those investigating the writing process.

Hayes suggests that while protocol analyses cannot be expected to be complete recordings of what goes on in the mind, they can give at least an indication. He likens protocol analysis to "following the tracks of a porpoise":

Its brief surfacings are like the glimpses of the underlying mental process which the protocol affords us. Between surfacing, the mental process, like the porpoise, runs deep and silent. Our task is to infer the course of the process from those brief traces. (63-64)

Criticism of protocol analysis by composition theorists ranges from delightfully satirical to more formally challenging. Robert Gorrell humorously parodies protocol analysis:

If I want to learn about the process of composing a stew, I can conduct research. I can interview various stewmakers, for example. I can watch them in action and take notes on what they do. Or I can put a microphone in front of them, getting them to recite what they think goes on in their minds as they peel turnips or stir the broth or decide whether to add cumin or oregano. I can check on whether a chef's hat or apron seems to have much to do with the process. I can analyze protocols and generalize about procedures that seem to characterize many of the cooks. I can perhaps identify different parts of the process--selecting and preparing ingredients, putting them together and cooking, tasting the results and seasoning--preparing, cooking, and revision--invention, arrangement, style. I can observe that these steps are not necessarily sequential; that for instance the cook may be selecting material even at the last stages, tasting and deciding to use more garlic. ("Mulligan Stew" 272)

Gorrell's parody suggests that protocol analysis may be a somewhat trivial procedure for analyzing the obvious.

On the other hand, Marilyn Cooper and Michael Holzman offer more serious criticism of the protocol methodology employed by Flower and Hayes: "Protocols, far from being 'extraordinarily rich in data,' are exceedingly impoverished sources of information on what writers are thinking about" ("Talking About Protocols" 284). Cooper and Holzman link protocols with "introspection," a technique used by Wilhelm Wundt in the seventeenth century. Wundt, regarded by some as the first modern psychologist, issued complex rules to be followed by those using the introspective method:

1. The observer must be able to determine when the process is introduced.
2. He must be in a state of "strained attention."
3. The observation must be able to be repeated several times.
4. The experiment must be able to be varied through variations in stimuli. (285)

Wundt used highly trained "introspectors," usually research assistants, in his investigations. His method was criticized at the time for limiting observation to "static and relatively simple mental states." Since the discovery of the unconscious, Wundt's technique has also been attacked for its inability to give data about unconscious activities of the mind. Also, many have been skeptical about the applicability of results obtained from such a small number of highly trained subjects (284-289).

Cooper and Holzman are among those who remain skeptical about introspection, and, consequently, protocol analysis. They contend that it is rather odd for people to talk about what they are thinking while they are doing something. Only those trained to think aloud can supply data. Thoughts running through people's heads are "diffuse, highly branched, visual as well as verbal." Flower and Hayes' introspectors notice "virtually nothing other than that which is to the point. Do these people never fantasize about, say, lunch?" (289-90)

Flower and Hayes, however, object to the comparison of protocol analysis with introspection. Wundt's method put "constraints" on what and how subjects observed, asking them to analyze their observations. For instance, instead of saying, "I see a book," subjects were asked to report on "Wundtian elements," giving statements like, "I see a dark reddish patch shaped like a parallelogram." The current protocol method, on the other hand, asks subjects only to "Say whatever comes into your mind." Another difference is that Wundt's introspectors made "thousands of practice observations" before actually participating in experiments, whereas subjects participating in the protocol method are purposely given very little training ("Response" 94-95).

Further, studies have shown that while introspection methods sometimes distort the subject's thoughts, protocol analysis does not. Ericsson and Simon (Protocol Analysis: Verbal Reports as Data), ask the question, "Does the act of reporting about mental

processes while they are going on alter the structure of those processes in a significant way?" Their research indicates that when subjects are asked to report on specific things while they perform a task (i.e., introspection), their processes being observed are likely to be modified. However, when subjects do not have to report on specific things, but just on what they are thinking (i.e., protocols), their processes may be slowed somewhat, but are not altered (Flower and Hayes, "Response" 95-96).

Flower and Hayes admit that protocol analysis is incomplete, but challenge Cooper and Holzman to come up with something better: "Any research method has its limitations. That is not news. The real question is, 'Is there a better method to do the job?'" (97)

In an article published almost two years after Flower and Hayes' response to Cooper and Holzman, Erwin Steinberg also defends protocol analysis ("Protocols, Retrospective Reports, and the Stream of Consciousness" 1986). In response to Cooper and Holzman's charge that protocol reports are too focused, not reflecting diffuse and non-verbal thoughts, Steinberg explains that when one's attention is focused on solving a problem, "consciousness is more tightly focused" than it is during other activities, such as daydreaming, in which we attend to other non-verbal thoughts and images.

Another criticism Steinberg addresses is that the presence of the observer and tape recorder distorts the process. He says any methodology has its limits and that in fact

Protocols may not reflect precisely what mental activity goes on during problem solving; but in thirty-five years they have enabled cognitive psychologists and specialists in artificial intelligence to model problem-solving methods quite carefully, as a considerable body of literature demonstrates. (700)

Steinberg also feels many "humanists" are threatened by protocol analysis because it represents "empiricism," but he argues that empirical techniques available from the social sciences and computer science are also useful in humanistic research (710).

Nevertheless, the conflict over protocols goes on. David N. Dobrin ("Protocols Once More," 1986), for example, criticizes protocol analysis not because of the method itself, but because of the model it presupposes. Dobrin's criticisms take us to the second category of dissent: the use of a cognitive framework for the study of writing.

The Validity of the Cognitive Framework

Dobrin's major objection to the cognitive model is that it assumes writing is "a problem-solving symbol-manipulation" procedure. To claim that the writing process is like solving math problems, which are well-formulated and have a single solution, is

to contradict our own writing experiences. Dobrin believes that the cognitive model is invalid because the activity of composing does not occur "at the focus of consciousness." Instead, during writing we tend to pause, to detach ourselves, to let our thoughts roam free, to perhaps look for something "upon the horizon of the mind, not recognizable, yet in existence" (722).

Dobrin suggests that it is legitimate to interview other writers about the way they write in order to research the writing process, and that it is also legitimate to "revive data extracted from onself." He believes that writing researchers should stop "trying to lay their work off on the cognitive scientists and instead listen to 'our own common sense' when it comes to studying writing" (724).

Others also object to considering writing a problem-solving process. Ann Berthoff has been vocal in her objections to both the idea of writing as a problem-solving process and the idea of using writing to solve problems.

Berthoff says that using writing to solve problems, while it "has the sanction of educational psychologists, systems analysts, defense intellectuals, and other technocrats because it promises guidelines, "structures, [and] models," keeps us from seeing that "certain contexts of the 'problem' are themselves problematical." She believes that problem solving hampers dialectics--questions which generate answers and then further questions--in favor of merely solving the "problem area" ("Theory of Imagination" 636-7).

Berthoff also attacks the cognitive framework which considers writing as a problem solving process, and calls today's cognitive theorists "the new brass instrument psychologists" who concern themselves with "what can be plotted and quantified," not with the things we truly want to know about the composing process, the writer's mind, or modes of learning. Instead of allowing the imagination to "be used and manipulated within the framework of positivist assumptions," it should be "reclaimed," to use as a "speculative instrument to focus on what it means to say that composing is a process of making meaning ("Intelligent Eye" 192-196).

Anthony Petrosky echoes Berthoff's challenge of positivist assumptions in his review of Linda Flower's textbook, Problem-Solving Strategies for Writing. Flower, says Petrosky, "succeeds not in presenting new and useful ideas. . . but in distorting even the old chestnuts by couching them in narrow notions of mind that smack of logical positivism." He further charges that the problem-solving approach "ignores reflective, associative, metaphoric, intuitive, and imaginative thinking" (233).

Flower, however, states that she has not ignored various types of thinking:

As a teacher, I see no contradiction at all between fostering the experience of discovery, of listening to readers, of reseeing one's own ideas--things we all value and teach toward--and asking students to bring a more self-conscious, problem-solving approach to their writing. ("Response" 96).

Flower believes that the heuristics she discusses are not positivist rules, but simply function to help students expand their repertoire of strategies for dealing with the writing process, whether they are writing a problem-solution paper, a short story, or a poem. A strategic approach to writing empowers students with an awareness of their own thinking process and a sense of options.

Yet others feel that Flower's--and other cognitive theorists'--emphasis on the writing process neglects individual processes. Robert Gorrell believes that it neglects process as it relates to product: "The writing process can be thought of as a process of ordering and relating ideas, attempting to achieve hierarchical patterns like some of those that can be described by analysis of the product" ("Mulligan Stew" 272-277).

Perhaps the best answer to criticisms of the cognitive model is a synthesis of several theoretical perspectives. Lester Faigley, for example, credits cognitive theories, along with expressive and social theories, with "giving student writing a value and authority absent in current-traditional approaches":

Expressive theorists validate personal experience in school systems that often deny it. Cognitive theorists see language as a way of negotiating the world. . . . And social theorists. . . have found that children who are labelled remedial in traditional classrooms can learn literacy skills by studying the occurrences of writing in the familiar world around them. ("Competing Theories" 541)

As Faigley's synthesis suggests, cognitive research, with its emphasis on process, illuminates certain aspects of the composing process. But it may need to be united with other elements of rhetorical theory which include the study of product. Cognitive research may indeed isolate "the part from whole," in its focus on process, but perhaps now the "whole" (process and product) must be considered, without rejection of knowledge gained from that necessary isolation of the "part" (542).

Even considering the need to merge cognitive research with traditional rhetorical theories, writing instructors can benefit from the pedagogical implications offered by cognitive research. Next follows a discussion of such implications.

CHAPTER VI PEDAGOGICAL IMPLICATIONS

Chapter III briefly discussed the concept of using writing to solve problems. Since the bulk of this paper has been devoted, rather, to writing as a problem-solving process, little space will be used for detailing strategies employing the former concept, even though there is a substantial body of research on the topic. Please refer to the bibliography for a list of some of those articles. Here I will simply describe one strategy offered by Richard Larson.

In Chapter III, Larson was cited as suggesting that students use problem-solving techniques to plan arguments on complex issues. Larson adapts a model of the problem-solving process for use in the classroom from a course offered at the Harvard Graduate School of Business Administration. His model includes eight steps, several of which echo John Hayes' breakdown of problem-solving steps (in Chapter II):

1. Definition of the problem (note the parallel to Hayes' category of "problem representation")
2. Determination of why the problem is a problem
3. An enumeration of the goals that must be served by whatever action is taken
4. Determination, where possible, of the goals which have highest priority
5. Invention of procedures that might attain the goals (Hayes' "search" category)
6. Prediction of the results that will follow the

taking of each possible action

7. Weighing of the predictions
8. Final evaluation of the choice that seems superior
(Hayes' category of "evaluating the solution")
(629-630)

Larson suggests that students become familiar with these steps and use them in writing about problems. For instance, perhaps the student wishes to write a letter to a current roommate about a problem with their living arrangement. The student can use these steps to structure the letter and plan an argument for a solution.

In addition to planning arguments, Larson suggests that these problem-solving techniques be used for reflection, discovery and invention, and for evaluating the arguments of others (635).

But this chapter has more to do with pedagogical implications for understanding writing as a problem-solving process, whether the writing be in the form of a problem paper, a poem, a short story, or an argumentative essay.

If writing instructors are willing to accept--even partially--the validity of the cognitive framework for studying writing as a problem-solving process, then a variety of pedagogical implications and heuristics are to be gleaned from research in this area. But translating theory and models into classroom techniques is not an easy task, for there are still no definitive rules to be laid out about the composing process. And there may never be, since the process of writing is so extremely complex: "There can be no 'Skinner box' studies of the composing

process, for isolating the composer and limiting his or her activity to one segment of the whole process simply falsifies what actually goes on" (Contemporary Rhetoric 17).

Therefore, the basis for any instruction "must finally be subjective and founded upon one's own estimate of results" (16). This section is just that: an informed but subjective estimate of how cognitive theorists' findings--about writing as a problem-solving process--can be applied to the writing classroom. Some specific heuristics and approaches will be detailed first, and then some general implications will be discussed.

Specific Heuristics and Approaches

In Chapter III, Linda Flower was cited as saying that she and John Hayes study writing as a form of problem solving in order to discover and describe "some of the basic heuristic procedures which underlie writing, and then to translate these heuristics into teachable techniques." Since their cognitive model was detailed in Chapter IV, it is now pertinent to discuss some specific heuristics that Flower and Hayes have gleaned from their model. However, first a discussion of the term, "heuristics," as it relates to the cognitive model of writing, is in order.

Background

Heuristics can be defined as "alternative(s) to trial and error," or the codification of useful techniques or cognitive skills employed as discovery procedures or ways of getting to a goal. Heuristics are not rules, but "alternative methods for doing something." As mentioned in Chapter I, people often intuitively use methods to solve problems without realizing what these methods are. Explicating those intuitive methods enables us to see them in terms of heuristics.

An example of a planning heuristic for writing offered by Linda Flower is "Make a plan to do and a plan to say." This heuristic differs from traditional outlines, or topic-based plans, in that it urges the writer to set goal-based plans, such as "I want to not only impress my audience of peers with my knowledge about electrical engineering, but I also want to come across as being aware of the ethical problems posed in this field." Once these types of goals are established, it is easier for the writer to plan what to say (Problem Solving Strategies for Writing). Notice that this heuristic takes the writer further than the traditional instructor's command to "Make sure your writing has a purpose."

D. N. Perkins (The Mind's Best Work) urges caution in teaching heuristics. Some of his reasons are: (1) Novices don't use heuristics as much as they could. Studies show that novices "have disclosed epidemic disorganization when the going gets

rough," even though they've been taught certain heuristics. (2) Students may know how to use a heuristic when asked to do so, but may not think to use it on their own. Teaching organizational strategies, along with heuristics, can help students remind themselves of ways to solve the problem before them. (3) People often change, or modify the heuristics they are taught. Instructors may be fooling themselves if they think students will carry intact the set of heuristics from their classroom to other classes or writing situations in the future. Though he poses these qualifications, Perkins would not have instructors quit teaching heuristics. Rather, he would simply have the potential of heuristics be put in perspective (195-206).

Others argue that the value of heuristics may be minimal. Irvin Hashimoto states that a student's "cognitive style. . . age, culture, intelligence, susceptibility to tedium, and beliefs, attitudes, and intentions" all have an impact on how effective heuristics will be. Shifts in perspective are not easily made by most people. Some students are not "intrinsically motivated" to develop "heuristic craving" ("Structured Heuristic Procedures" 74-76).

Flower and Hayes admit that the experienced writer "comes equipped with many well-engrained, if counter-productive habits," which interfere with adopting new heuristics. They stress that a heuristic must be presented in the classroom as an experience, one which will enable the writer to actually learn how to use and

apply the technique. Rather than simply present a formula, it is necessary to first change the behavior of the student in order for the student to assimilate the heuristic ("Problem-Solving Strategies and the Writing Process" 461).

Virginia Allen Underwood, whose 1980 dissertation surveys rhetorical heuristics, suggests that certain heuristics should be used in certain situations, depending on the rhetorical problem. However, she suggests, composition instructors should resist the pervasive temptation to simplify the writing process into overly-prescriptive heuristics (325-8):

We may yearn in vain. . . for a perfect heuristic--simple, elegant, and complete--to bring bear on any problem, and in the end we may be left with Polya's (George Polya, author of How to Solve It: A New Aspect of Mathematical Method, 1945) two rules of discovery: "The first rule is to have brains and good luck. The second rule is to sit tight and wait until you get a bright idea."
(328)

It is apparent that composition theorists receive the idea of teaching heuristics with varying degrees of enthusiasm. This should not be surprising, considering the equally controversial reception of protocol methods and the use of the cognitive framework in investigating writing. Still, I hope the reader will review heuristics generated by cognitive researchers with an open mind, as the focus below turns to specific pedagogical strategies that may be taught in the composition classroom.

Cognitive-Based Heuristics

Linda Flower's textbook is a good place to start for identifying specific heuristics that can be taught in the composition classroom. The text is organized around nine steps for the composing process, and each step contains strategies, or heuristics, for writers to employ. The steps and strategies, which closely parallel the cognitive model discussed in Chapter IV, are listed below.

Steps and Strategies for the Composing Process

- Step 1: Explore the Rhetorical Problem
 - Strategy 1: Test your image of the problem
 - Strategy 2: Explain the assignment to yourself
- Step 2: Make a Plan
 - Strategy 1: Make a plan to do and a plan to say
 - Strategy 2: Make your goals operational
 - Strategy 3: Reveal your plan to the reader
- Step 3: Generate New Ideas
 - Strategy 1: Turn off the editor and brainstorm
 - Strategy 2: Talk to your reader
 - Strategy 3: Systematically explore your topic
 - Strategy 4: Rest and incubate
- Step 4: Organize Your Ideas
 - Strategy 1: Expand your own code words
 - Strategy 2: Nutshell your ideas and teach them
 - Strategy 3: Build an issue tree
- Step 5: Know the Needs of Your Reader
 - Strategy 1: Analyze your audience
 - Strategy 2: Anticipate your reader's response
 - Strategy 3: Organize for a creative reader
- Step 6: Transform Writer-Based Prose into Reader-Based Prose
 - Strategy 1: Set up a shared goal

Strategy 2: Develop a reader-based structure
 Strategy 3: Give your reader cues
 Strategy 4: Develop a persuasive argument

Step 7: Review Your Paper and Your Purpose
 Strategy 1: Compare your paper to your plan
 Strategy 2: Simulate a reader's response

Step 8: Test and Edit Your Writing
 Strategy 1: Edit for economy
 Strategy 2: Edit for a forceful style

Step 9: Edit for Connections and Coherence
 Strategy 1: Transform listlike sentences
 Strategy 2: Reveal the inner logic of your paragraphs

Flower's text is basically an explication of these steps; it translates the cognitive model of writing into specific heuristics that writers can use to improve their writing skills. While most of the steps and strategies listed above are parallel to Flower and Hayes' cognitive model, a few are not.

Flower notes in her preface that her book attempts to combine "traditional rhetorical concerns" with "current research in composition" (vii). Thus, some of the strategies above reflect traditional rhetorical heuristics. For instance, brainstorming (Step 3, Strategy 1) has long been a technique taught not only in composition, but also in other disciplines. "Systematically explore your topic" (Step 3, Strategy 3) is a compilation of well-known rhetorical heuristics for invention: (1) Aristotle's *topoi* (which she discusses as Aristotle's "topics"); (2) Young, Becker and Pike's *tagmemics*, and (3) William Gordon's *synectics* (83-85). Flower also borrows methods from traditional audience

analysis in Step 5, Strategy 1, when she suggests that students analyze the knowledge, attitudes, and needs of their audience, and also that students distinguish between their primary and secondary audience (132-133). Steps 8 and 9, which include suggestions for editing, are also based on well-known, traditional techniques.

The remaining heuristics, however, are based on Flower and Hayes' cognitive research and are drawn directly from the material discussed in Chapter IV. (The reader is encouraged to refer to Flower's textbook for further explanation, which is very "reader-based," geared well to novice and expert writers.) The important fact here is that the three major elements of solving problems that John Hayes discusses (see Chapter II) are visible in these heuristics. The first element is "problem representation," which Flower incorporates into Step 1: "Explore the Rhetorical Problem." The second element is "search," which is evident in Steps 2 and 3: "Make a Plan," and "Generate New Ideas." The third element that Hayes discusses is "evaluating the solution," which Flower incorporates into Step 6, "Transform Writer-Based Prose into Reader-Based Prose," and Step 7, "Review Your Paper and Your Purpose." A few heuristics from each category merit explanation.

Problem Representation:

Within the category of "problem representation," Flower defines a rhetorical problem as a "rather large, uncharted

territory" that contains the writer, the reader, and the writer's ideas and purpose. She gives the writer three heuristics, in the form of questions, with which to explore his/her problem representation. They are:

1. Do I have a mental image of my purpose or goal?
2. Do I have an image of my reader, in particular, an image of what my reader might need or expect from my paper?
3. Do I have an image of my own projected self as the writer--a sense of how I am going to sound in print?

Flower reminds the writer that the rhetorical problem will only be a sketch--that details will be filled in and changed as the process continues. But people only solve the problems they give themselves to solve, so the picture of the problem should be as thorough as possible. These heuristics will thus aid in picturing the problem, or the problem representation (64-66).

Richard M. Coe and Kris Gutierrez ("Using Problem-Solving Procedures and Process Analysis to Help Students with Writing Problems") offer an excellent series of assignments designed to help students with precise problem-representation in regard to solving their own writing problems. Their three assignments help students to (1) become more aware of their writing processes, (2) define their strengths and weaknesses, and (3) set their own goals for future writing projects--thus employing many of the heuristics Linda Flower advocates. The assignments are spread over a period

of time. Assignment A asks students to think of something they've written recently and narrate everything they did from the time they started to the time they finished. Assignment B asks students to discuss their strengths and weaknesses by rereading past assignments with comments for different instructors. Assignment C builds on the first two, asking students to list strengths and weaknesses and then establish goals for overcoming some of their writing problems.

Students writing these assignments may end up setting such goals as "I will make an issue tree after my first draft so that I can see how my paper needs to be reorganized, in order to combat my problem of disorganization," or "I will proofread my paper several times before I hand it in, reading once for certain misspelled words that I normally have problems with, once for subject-verb agreement, and once to make sure I'm not inappropriately switching verb tenses." Thus Coe and Gutierrez's assignments can be useful as an exercise in problem representation and solution, using such heuristics as improving problem representation, making operational plans, and setting evaluation criteria.

Search:

For the category of "search," Flower offers several heuristics, such as the "Make a plan to do and to say" heuristic

discussed above. Other search heuristics she suggests, in addition to brainstorming, Aristotle's topoi, and synectics, are to (1) talk to the reader, and (2) "rest and incubate." Since people come up with some of their best ideas when engaging in a face-to-face discussion with another person, talking to one's reader can be a powerful strategy. If the reader is unavailable, the writer can role-play, trying to anticipate the reader's reactions and questions (82). Resting and incubating involves formulating an unsolved problem, and then getting away from thinking about it for awhile. Thus, starting a paper early is a good tactic (86).

Another search heuristic is the "fractionation" method discussed in Chapter II. Here, the writer breaks the task into parts, rather than being overwhelmed by the entire task at once. Thus, the task may be broken into such parts as research, brainstorming, organization, writing a rough draft, and revising. Some of these tasks may even be broken further. For instance, revision may be split into such tasks as "evaluating," and "diagnosing."

Again, search heuristics like "talk to the reader," "rest and incubate" and "break the task into parts" have been gleaned from cognitive research on expert and novice writers--they are heuristics that work for many experts.

Evaluation:

A heuristic offered for the category of "evaluation" is that of transforming writer-based prose into reader-based prose. As discussed in Chapter IV in conjunction with long-term memory, writer-based prose "faithfully reflects the writer's own discovery process and the structure of the remembered information itself," but fails to make the transformation or reorganization necessary for the needs of the reader. Flower suggests that writers thus transform writer-based prose into reader-based prose as part of their evaluation process. Specific heuristics for accomplishing this task include (1) setting up a shared goal, or finding a reason for writing the paper and a reason for reading it; (2) developing a reader-based structure, which may entail a more logical organization; (3) giving the reader cues, such as previews, summaries, and guides; and (4) developing a persuasive argument, which includes serious thought about the reader's point of view (160-180).

Roland Huff ("Teaching Revision: A Model of the Drafting Process") employs many of Flower's evaluation heuristics--and more--in his discussion of how to teach the drafting process to students. Huff suggests a three-stage drafting process: (1) zero-drafting (the student initially discovers a topic); (2) problem-solving drafting (problems with the draft's conception and organization are identified and resolved); and (3) final drafting (students attempt to arrive at the best solution for their

rhetorical problem). While these stages are presented sequentially, Huff's intent is not to "define drafting as a three-stage process" (802), but to help students develop an awareness of strategies needed.

For each draft, Huff offers specific heuristics. For instance, for the problem-solving draft he has students answer such heuristic questions about audience as: "How old are members of this audience?" "Where do they live?" "How well-educated are they?" About the writer's stance, he asks, "How well-informed is the writer about this subject?" "How well-educated in general?" "How is the writer dressed?" Thus, each draft the student writes is aided by heuristics like the above.

Indeed, some may well question what's so new about heuristics such as Huff's and Flower's listed above. The heuristics may seem sensible and even trite. Some people already employ many or most of them. The key is that most of these heuristics are already employed by expert writers, but not by novice writers. In other words, the findings may simply verify what "good" writers and some writing instructors have already intuited. Some instructors may have been teaching some of these heuristics for years on their own, without ever having heard of Linda Flower, and these instructors should feel validated by Flower and Hayes' research. Probably more teachers, however, have used some of these heuristics in their own writing, without ever having

conceptualized them in such a way as to be useful for their students, who are novice writers.

For the instructor who feels frustrated by the lack of teaching tools in the writing classroom, for those who feel something lacking in the traditional modes of description, exposition, narration, and argument, Flower's heuristics may be a welcome teaching tool.

Personal Commentary:

I have had positive experiences with Flower's heuristics the past two semesters in my freshman composition classroom at Iowa State University. What I appreciate most about the heuristics is that they provide a common language with which to work from. For example, I consider it a powerful tool to be able to say to students, "This needs to be more reader-based," knowing that they will understand that I want them to set up shared goals and give the reader cues, rather than be puzzled, and perhaps frustrated, by a directive like "This needs coherence."

I have several goals when using Flower's text. First, I have students read the entire text by mid-semester, with rereadings of sections afterwards. This ensures time to incorporate a large variety of heuristics in various writing assignments. Second, I have students experience the heuristics offered by Flower, through small-group activities or individual conferences, though some of the heuristics are best illustrated with the class as a whole. If

the student views an untried heuristic as very awkward or unwieldy, s/he may not attempt it on her/his own or in a small group. For example, the heuristic of building an issue tree seems complicated to some, and may be more productively experienced in the class as a whole. Third, I try to help students understand that they will probably pick, choose, and modify the heuristics they learn in my class. Fourth, I attempt to help students realize that they can apply the heuristics they learn and modify in my class to other writing situations, whether academic, business-related, or otherwise. Thus, I try to aid students in internalizing the heuristics by basing my evaluations and grades on whether or not they use them in their rough drafts and revisions.

My students' feedback regarding the text itself varies. Some find it engaging, while others find it fairly tedious to read. However, most feel that the strategies they learn are worthwhile, and help them in their writing. Some have suggested that I teach the strategies without requiring them to buy and read the book. Since I also use a reader in my classroom, I have been tempted to teach Flower's heuristics without the text, in order to lower the student's cost of buying two texts. However, I have been reluctant to discard Flower's text because--and I stress this to my students--the book can be so helpful to them beyond my class.

Some students have objected to being put through the paces of so many different strategies/heuristics. Perhaps they are the

ones who don't develop the "heuristic craving" that Hashimoto talks about. But there is the danger of instruction becoming too heuristic-oriented, thus interfering with the student's own strategies, which may be good ones already. An instructor may need to loosen up his/her heuristic hold on the classroom at times, but a looser, cognitive-based approach can still be effective. Some of these more general approaches will now be discussed.

Cognitive-Based Approaches

Jack Selzer ("Exploring Options in Composing") warns that teachers, in the rush to apply basic research on composing to the classroom, often "attempt to impose a single, 'ideal' composing style on to their students" (276). Further, teachers fail to acknowledge that individual students may compose differently in different situations. For instance, students "may plan and revise freshman essays only superficially" (281) because they consider the task unimportant, but may write several drafts of a letter for a job application, which may be more important to them.

Selzer suggests several ways for instructors to help expand their students' composing repertoires. First, they can expose students to a "variety of composing styles and actions," through descriptions of how other writers have responded to various writing tasks. Journals kept by the students about their writing processes, with results shared in the classroom, might help

illustrate the differences in processes. Second, students need to experience composing options themselves through a range of assignments, such as "in-class essays and exercises, personal letters, lengthy formal essays, and the kinds of writing required in various disciplines" (282).

Certainly Selzer's concerns need to be heeded by instructors teaching heuristics such as the ones Linda Flower offers. It is important not to over-prescribe, to remember that writing is not a well-defined problem, but an ill-defined one, not solvable by algorithms. Heuristics provide no guarantee of a solution, and instructors should not teach them as if they do.

In addition to Selzer, other researchers' works offer implications for approaches in the writing classroom. Research on writer's block, knowledge-telling, pre-text, the affective domain, the link between reading and writing, and creativity (all discussed in Chapters II and IV), yields information that instructors may find pedagogically useful.

Writer's Block:

When students apply heuristics to their writing as if they are algorithms, writer's block may well occur, as discussed in Chapter IV. Mike Rose suggests that rather than freeing up "stymied writers" with a list of techniques and tricks, instructors need to investigate students' processes, as well as their products, in order to discover what inflexible rules are

causing the block. He suggests several ways to gain entry to process. One is to have students bring every scrap of paper used for a recent assignment and question them about previous writing experiences, then more specifically about their written work. Their answers may yield important information about rules that they may have internalized. Second, students may compose in front of the teacher, with the teacher asking questions immediately after. Third, students may be asked to do their own protocol analysis, with teacher and students together pinpointing specific process problems. Once information is gathered, students' problematic assumptions can be remedied by "conferences, tutorials, lessons, readings, CAI programs, and small-group work" (84-87).

Knowledge-Telling:

In addition to the possibility of heuristics being used at the wrong time in the writing process, heuristics may not be beneficial for overcoming the knowledge-telling behavior discussed in Chapter IV. Recall that knowledge-tellers reduce writing assignments to "topics," with no explicit goals of their own for the assignment except for telling what they know about the topic. Goal-related knowledge, say Scardamalia and Bereiter, seems to come rather late in writing development ("Assimilative Processes 165-170). Verbal strategy descriptions, or heuristics, may not

help the knowledge-teller, because they presuppose a "high level of metacognition" which allows one to assess and manipulate one's cognitive strategies. Further, heuristics presuppose an "existing executive strategy" already developed enough to incorporate the heuristics (Scardamalia and Bereiter, The Psychology of Written Composition 252).

Rather than teaching heuristics to combat knowledge-telling, Scardamalia and Bereiter suggest directing instructional effort toward "self-regulatory mechanisms," which may eventually result in the student acquiring heuristics. Basically, a self-regulatory mechanism is a type of a building block, which allows for later internalization of specific heuristics or strategies. An example of a self-regulatory mechanism is "goal concretization," where the instructor substitutes "goals of a more concrete and stable type than those naturally occurring in compositional tasks" (252-253). For instance, the instructor may give an ending sentence and ask students to write compositions leading up to the specified ending sentence, which provides the concrete goal for the students (259). Another example of supplying a concrete goal is shown in the following description of an assignment:

Students are grouped into teams of three to discuss interesting personal experiences. They choose one person's experience, discuss it in detail, and each student goes off to write about it as if it happened to him or herself. The teacher may remind students that their stories should contain no real names. Each student in a team reads his or her story aloud and the class tries to guess which of the three stories was

written by the person the experience actually happened to. The writer succeeds by convincing the class that his or her narrative is the true account. (260)

The concrete goal in this example is to produce a fictitious narrative that will pass for a true account. A more abstract and intangible, and therefore less reachable, goal would be to "write a realistic narrative." This goal does not provide the concrete goal that supplying an ending sentence does. Providing knowledge-telling students with concrete goals brings the students closer to "the full act of dealing with emergent goals" (260).

Though Scardamalia and Bereiter's research focuses mostly on students in elementary and secondary schools, certainly college instructors are familiar with "knowledge-telling" and can benefit from their suggestions for helping students move beyond it.

Pre-text:

More teaching approaches can be gleaned from the work of other theorists discussed in Chapter IV as well. For instance, Stephen Witte's findings on pre-text may as yet yield no specific strategies, but his work helps to qualify the idea that heuristics for revision should happen toward the end of the composing process. Recall that pre-text is "the writer's tentative linguistic representation of intended meaning" which is stored in the writer's memory and sometimes manipulated mentally prior to being written down. Witte suggests that students should

understand that they may have a powerful medium with which to explore composing problems "without the added problem of juggling all the constraints of formal written prose" (417). Implicit in Witte's research is the idea that instructors can encourage students to spend time thinking about their drafts before they actually write. Activities might be designed which have students talk their first drafts into a tape recorder, or with another student, in an effort to acquaint students with the concept and power of pre-text.

Affective Domain:

Susan McLeod's work with the affective domain in writing also has implications for instruction. McLeod suggests that students become aware that most writers are "agitated" as they compose, and that students can "learn to find that agitation enabling rather than debilitating." Further, students should realize that the feeling of pleasure they have when a first draft is finished is not necessarily an indication that the entire task is done. Says McLeod:

We can work out specific coping strategies to help students control their affective reactions--monitoring their emotional state, allocating their energy, stopping themselves when they are over-excited--so that their emotions work for them rather than against them. (433).

In order to include the affective domain in composition instruction, writing instructors could have students monitor their feelings of agitation, pleasure, anxiety, and excitement as they write a paper. These feelings could then be discussed and compared in class, which could help students to be more aware of the affect their feelings have on their writing.

Reading and Writing:

Research by those such as Bracewell, Frederiksen, and Frederiksen and Kucer on the link between discourse production and comprehension, or between writing and reading, is still in a very theoretical stage. Thus, pedagogical implications are sparse. At the very least, their research implies what most teachers are already aware of--that writing cannot escape the context of reading. Therefore, instruction in writing must also involve instruction in reading. This implies that writing instructors must be aware of research done in both writing and reading.

Creativity:

Cognitive research in creativity can also shed light on composition instruction. In answer to the question, "Can an individual become more creative?" John Hayes says there are at least three things that people can do to increase their chances of being creative. The most difficult is to develop knowledge bases

in the fields they are interested in. He also recommends that people "create the right atmosphere for creativity." This involves such techniques as brainstorming or searching for analogies. Because people "often fail to notice that a new problem is really an old problem" that they already know how to solve, they may spend "unnecessary time solving it anew." Analogies can help people recognize that they are solving old problems. Hayes, like Flower, cites "synectics" as a way to invent analogies, with its classification of analogies into four categories: personal, direct, symbolic, and fantasy (237-240).

D. N. Perkins is another researcher who has focused on cognitive theories of creativity. Author of The Mind's Best Work, Perkins has used protocol analysis to study the creative processes of various artists. He offers a set of heuristics for those interested particularly in the invention stage of creativity. Following is a paraphrase of his advice:

1. Try to be original.
2. Find the problem. Explore the alternatives, and be flexible.
3. Strive for objectivity.
4. Search as necessary and prudent. Explore alternatives when the present routine fails, or even explore alternatives routinely.
5. Try, to don't expect, to be right the first time. You may have to "satisfice" (or settle for something that is "good enough").
6. Make use of noticing. Use your ability to notice patterns which are relevant to a problem.
7. When stuck, change the problem. "Any problem can be solved--if you change the problem into a related one that solves the real problem."
8. When confused, use concrete representations. Making

- thoughts concrete can help to clear confusion.
9. Practice in a context. Practice creativity with an activity you often undertake and try hard to be more creative in that.
 10. Invent your behavior. Criticize, revise, and devise ways you do things important to you. (214-219)

Again, many of these heuristics employ the previously identified important elements of problem-solving: problem representation, search, and evaluation.

In cognitive research, writing instructors have at their disposal some exciting and concrete heuristics and promising approaches with which to approach the classroom. These may be methods that some instructors have already intuited and used in their classrooms; for most, however, these methods are a viable alternative to the "Here, let me do it," approach that many, for lack of a better method, find themselves using in conferences and written evaluations.

General Implications

Norman Frederiksen says, "The primary missions of educational institutions, from elementary to graduate and professional schools, are to impart knowledge and to teach cognitive skills. One of the most important cognitive skills is no doubt problem-solving ability" (Frederiksen 363).

Frederiksen says that instructors do know enough to teach specific skills such as the use of algorithms in mathematics, but

in the area of ill-structured problems, instructors know little about how to teach students to develop representations of ill-structured problems, to make plans for solving such problems, or to use the appropriate strategies or heuristic approaches (396).

Much needs to be learned about how ill-structured problems are solved, however, because

Many of the problems we face in real life, and all the important social, political, economic, and scientific problems in the world, are ill-structured (Simon, 1973). Schools seldom require students to solve such fuzzy problems--problems that are not clearly stated, where the needed information is not all available, there is no algorithm, and there may not be a single answer that can be demonstrated to be correct. (363)

Frederiksen feels that methods of solving ill-structured problems do exist, and can be "taught in such a way that they can be used in new domains where they are relevant" (363).

Kenneth Pfeiffer, Gregory Feinberg, and Steven Gelber agree that these methods do exist, but say that "there is little evidence that general problem-solving skills have been taught effectively" ("Teaching Productive Problem-Solving Attitudes" 99). Their hypothesis is that "researchers have focused too much attention on what to teach students to make them better problem solvers, instead of how to teach students" (100). They feel that educators need to think less in terms of causing specific changes in the student, "as though there [is] a direct, one-on-one

relationship between what is taught and what is learned," and more in terms of facilitating "practice and active participation by the student" (99-100). (There is a clear parallel here to teaching writing as process, rather than product.) They use the analogy of riding a bicycle: it requires active participation by the student, with a lot of practice, rather than sitting passively, trying to learn how from the teacher. Thus, they feel that "general problem solving can be taught if the teacher provides not only facts, but also practice, feedback, and motivation" (102). The teacher needs to play the role of a coach, or motivator and facilitator, rather than merely a giver of knowledge.

If instructors "buy" the idea that writing is a problem-solving process, explorable by methods such as protocol analysis, and that the writing process (not that there is only one process, but a rough sketch of elements common to various writing processes) can be conceptualized into a type of a cognitive model, then there are at least a few general implications that can be made about teaching writing. Those buying into this idea certainly must be aware of the controversy that surrounds cognitive research into such a complicated mental process such as writing; that controversy has been touched upon in Chapter V. Buyers must also be aware that a cognitive model, such as the one offered by Flower and Hayes, may look deceptively simple--that the intent is not to show writing to be a stage-like process, beginning with one step and ending with another. Rather, writing

consists of a complicated set of thinking processes which have a hierarchical organization based on processes embedded within other processes. Writing is a "goal-directed thinking process, guided by the writer's own growing network of goals." These goals may be changed or substituted by new goals as the process continues (Flower and Hayes, "Cognitive Process" 386-7).

If instructors buy this parcel of cognitive goods, then certain implications become apparent. First, the concept that writing is a mysterious process and thus unteachable may not be accurate. This concept was influenced by the Romantic movement and is held at some level, implicitly or explicitly, by many instructors today. Rather, it is possible that while writing may not be an algorithmic process which is teachable through strict rules, there may be some basic, teachable heuristics to use for instruction. Thus, writing, or at least certain elements of writing, is teachable.

Second, results of cognitive research of writing as a problem-solving process imply that information about the writing process can be used as subject matter in the classroom. This is not to say that traditional literature subject-oriented classrooms will be a thing of the past. Reading literature and writing about it will always be a thought-provoking, viable activity in the classroom. However, cognitive research enables instructors to discuss and present writing as a process, and to design activities (such as those employing heuristics) around that process. Most

instructors are at least vaguely aware of the "process" theory of writing and use texts which give lip service to the stages of "prewriting," "writing," and "rewriting." But this stage theory is not the same concept as the cognitive research model. Cognitive research goes several steps beyond the stage theory in its assertion that writing is not orchestrated in stages, but recursively, embedded hierarchically. Thus, cognitive research gives instructors a subject and focus to talk about regarding the writing process itself.

Third, cognitive research gives instructors something to do besides talk in the classroom. The traditional method of lecturing has long been criticized, but some writing instructors have been at a loss of what to do instead. Again the analogy of learning to ride a bicycle is useful in teaching problem-solving attitudes. Learning to ride a bicycle requires active participation by the student, with a lot of practice, rather than sitting passively, trying to learn how from the teacher. The writing instructor, like the bicycle instructor, needs to play the role of a coach, or motivator, rather than merely a giver of knowledge. This is possible when the instructor uses heuristics derived from cognitive research to "coach" with, such as the ones described in this chapter. In fact, it is more helpful for the instructor to encourage the students to experience the heuristics than it is to merely present them in lecture-fashion.

Happily, this approach meshes well with the "environmental mode," or approach, that George Hillocks, Jr. asserts is most effective in the composition classroom, in contrast to several other approaches. Hillocks uses meta-analysis to compare results of countless experiments and research on composition. His 1984 article, "What Works in Teaching Composition: A Meta-analysis of Experimental Treatment Studies," and his more recent book, Research on Written Composition: New Directions for Teaching (1986) contain a detailed discussion of the process of meta-analysis. In both these works, Hillocks identifies and compares the effectiveness of four modes of instruction. They are presentational, natural process, environmental, and individualized.

The presentation mode is perhaps most familiar to those who have been educated in a traditional college or university. It can be characterized by the following: clear and specific objectives, lecture and teacher-led discussion dealing with concepts to be learned and applied, the study of models, assignments that usually involve imitating a pattern, and feedback coming mostly from the instructor. Hillocks found that presentation treatments in his study were three times more frequent than any other ("Teaching Composition" 143).

The natural process mode includes: general objectives, free writing as a way of exploring a subject, writing for peers as audience, generally positive feedback from peers, frequent

opportunities for revision, and frequent student interaction. In this mode, there is a low level of structure, and the instructor is generally nondirectional about the qualities of good writing (143).

Characteristics of the environmental mode include clear and specific objectives, materials and activities aimed at engaging students with each other in specific processes important to particular aspects of writing, and activities conducive to high levels of peer interaction on specific tasks. In this mode, teachers minimize lecture and teacher-led discussion, usually having students work on specific tasks in small-groups and then independently. Principles are not just announced and illustrated by the instructor; rather, the students are engaged in working through them. Hillocks suggests that while the presentational mode emphasizes the role of the teacher as presenter of knowledge about writing, and the natural process mode emphasizes the student as the generator of ideas, the environmental mode "appears to place teacher and student more nearly in balance"; thus the term, "environmental" (144-145).

The individualized mode is fairly self-explanatory. Here, students are instructed on an individualized basis through tutorials or programmed materials (or a combination of both) on such things as mechanics, researching, planning, and writing papers (146).

Through his meta-analysis, Hillocks found that "the environmental mode is responsible for higher gains than the other modes." The differences (based on pretest-to-posttest results), among the presentational, natural process, and individualized modes are not significant, but the environmental gain is three times the gain for the others (147-9). Hillocks says,

In contrast to the presentational mode, (the environmental mode) places priority on high levels of student involvement. In contrast to the natural process mode, the environmental mode places high priority on structured problem-solving activities (emphasis mine), with clear objectives, planned to enable students to deal with similar problems in composing. (160)

Thus the environmental mode, which proves, at least according to Hillocks' study, to be the most effective mode of instruction, is also the mode which places high priority on problem-solving activities, of which the writing process is one. The environmental mode, combined with teaching writing as a problem-solving process, can give instructors something to do besides lecture to a class full of half-interested students.

If instructors believe that at least parts of the writing process can be taught in terms of problem-solving, and if they have tools, or heuristics, with which to teach that are based on legitimate cognitive research, and if they are freed from the lecture-based approach with which they were most likely taught, then perhaps writing instructors will no longer speak quite so

often of working "in the trenches" as they teach composition courses.

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